UNCOMMON GI CAUSES OF THE ACUTE ABDOMEN: CT DIAGNOSIS

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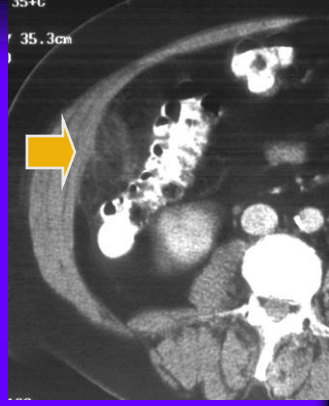
Introduction

- A spectrum of ten uncommon/unusual but GI causes of acute abdominal and pelvic pain may be diagnosed prospectively on CT.
- Radiologists and clinicians need to be aware of these disorders even when uncommonly encountered, particularly with the widespread use of CT to image patients in recent years.
- I have no disclosures related to this presentation

Ten Etiologies to be Covered:

- Omental infarction
- Intussusception in adults
- Small bowel obstruction from internal hernia
- Cecal volvulus
- Intramural small bowel hemorrhage
- Esophageal intramural hematoma and Boerhaave's syndrome
- Luminal foreign bodies
- Hemorrhagic tumors
- Gallstone ileus
- Tenth unknown case

Omental Infarction

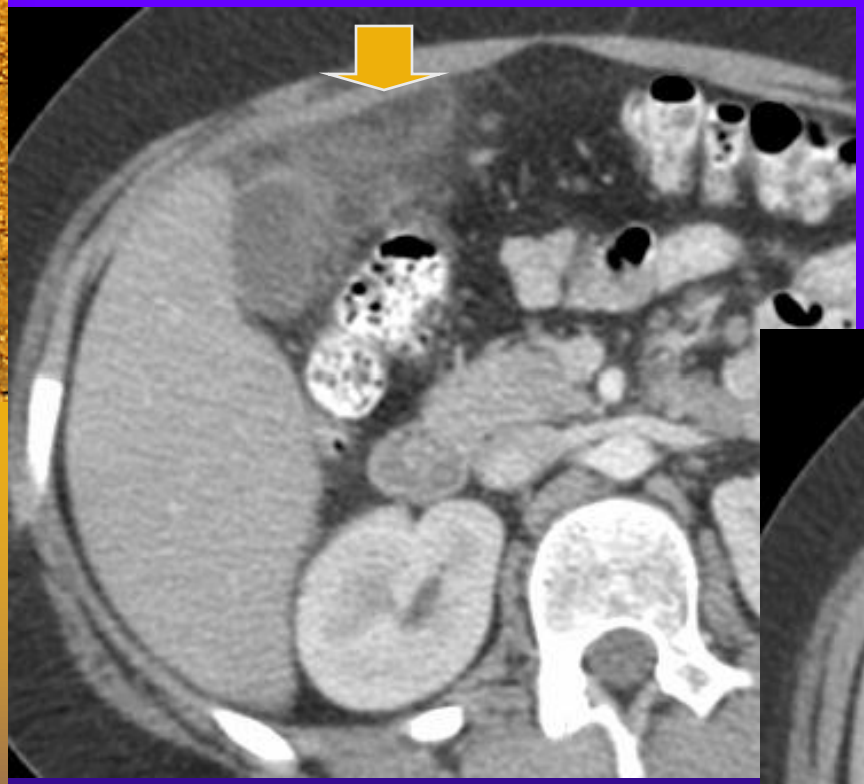


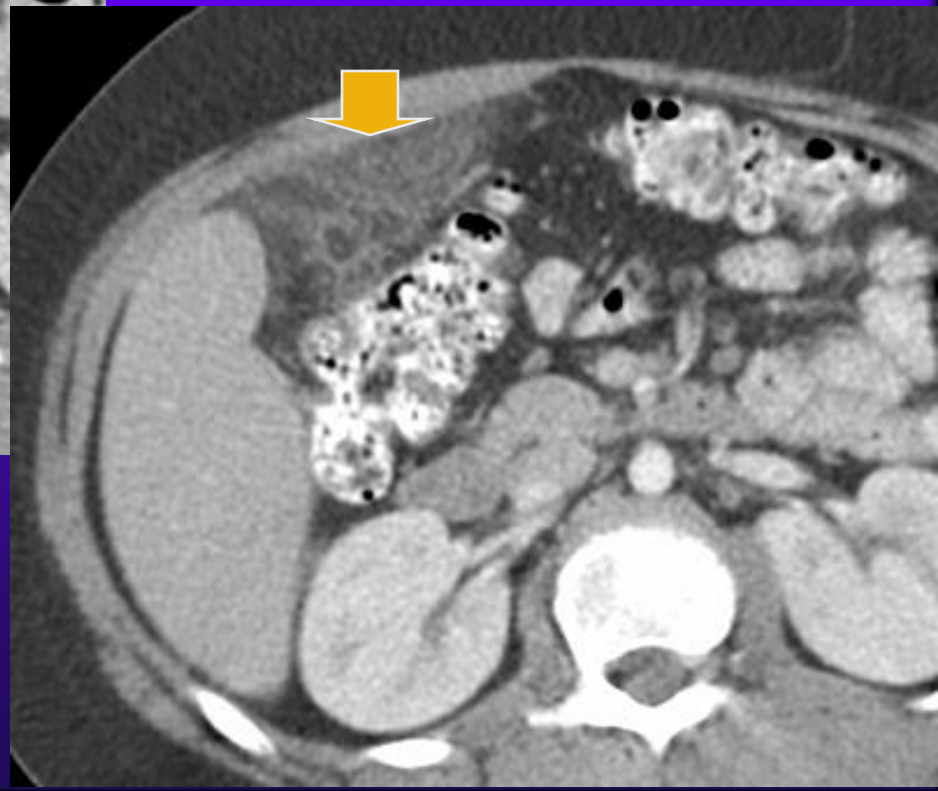
- Uncommon but increasingly reported prospectively on CT (Abadir JS et al. Am Surg 2004; Garg AG et al. Semin US CT MR 2008; Singh AK et al. Abdom Imaging 2006; Kamaya A et al. RG 2011; Kani KK et al. Curr Probl Diagn Radiol 2012; Javed AA et al. J Gastrointest Surg 2015)
- Exact etiology unclear unless secondary to torsion
- Associated with obesity, trauma, recent or prior surgery (e.g., gastric or distal pancreatic), strenuous activity, spontaneous venous thrombosis, & even ‘tight pants’; right-sided predominance - ? predisposition to thrombosis due to variant/more tenuous blood supply
- Can present at any age – sharp, constant pain
- Several small series reported in children (Rimon A et al. J Pediatr 2009; Nubi A et al. J Pediatr Surg 2008)

Omental Infarction

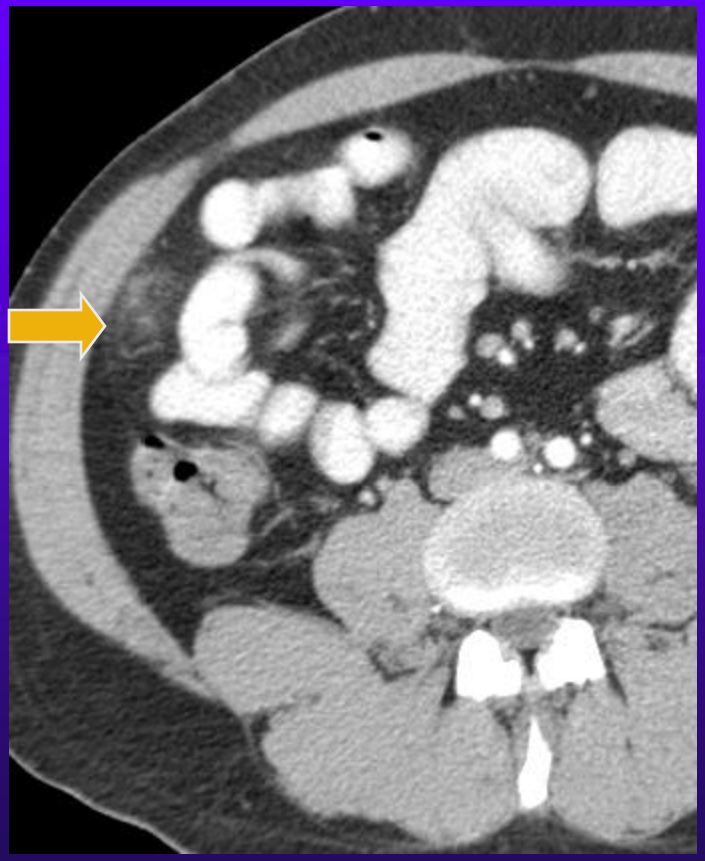
- CT findings: inflammatory mass with fat/fluid in para-umbilical region between rectus sheath & transverse colon; adjacent bowel unremarkable or mild thickening
- - "whirl" pattern in torsion – diagnostic
- - may overlap in appearance but usually larger (> 5 cm) than the inflammatory process in epiploic appendagitis – & the latter is more commonly left-sided (van Breda Vriesman AC et al. Abdom Imaging 2002; Singh AK et al. RadioGraphics 2005)
- Mgmt. usually conservative unless torsed (Itenberg E et al. J Surg Educ 2010)
- Follow-up CT – smaller, better-defined, dense rim

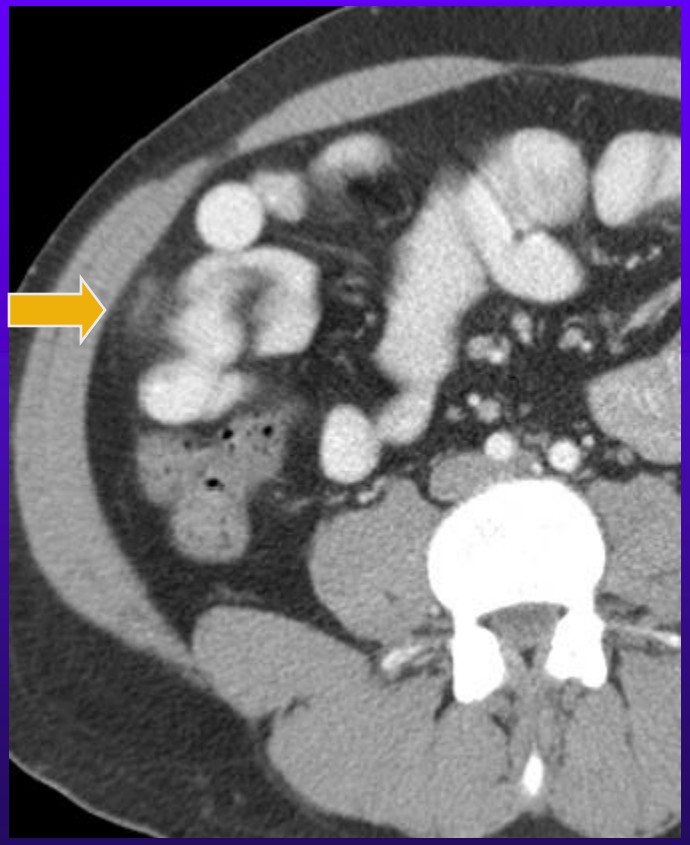
9-year-old boy with 5 days of right upper quadrant pain



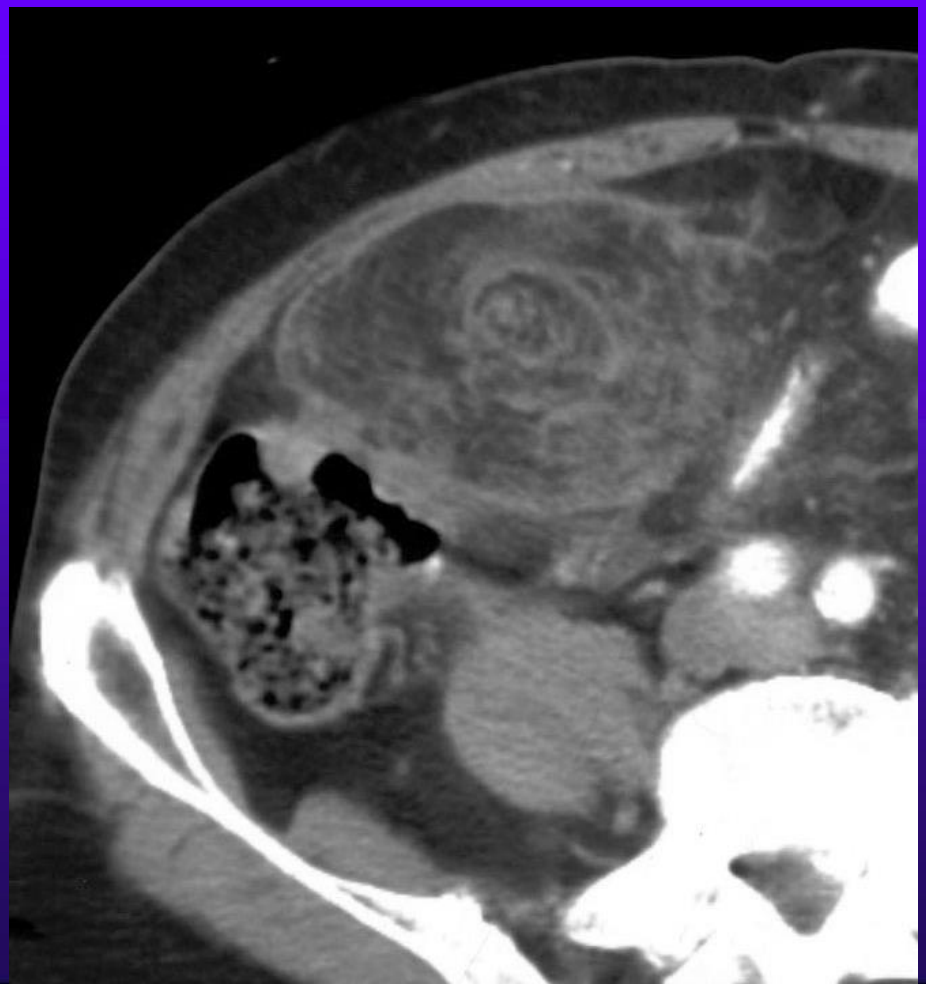


35-year-old man with 4 days of RLQ pain – c/w small right omental infarct



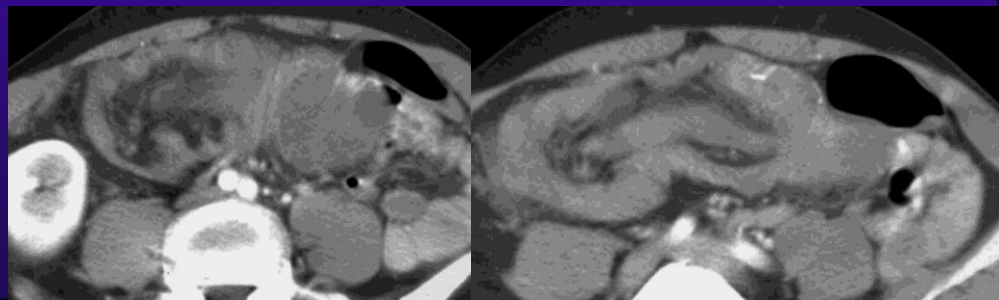


81-year-old man, rt. abdominal pain, s/p rt. diaphragmatic & inguinal hernia repair



Intussusception in Adults

- Very different entity in adults than in young children
- 90-95% with an identifiable pathologic focal process as the leading point, when colonic
- Symptoms may be acute, intermittent, or chronic
- Diagnosis should be established prospectively on CT (Baleato-Gonzalez S et al. Emerg Radiol 2012)
- Leading point - malignant tumor in ½- ¾ colonic cases (Azar T et al. Ann Surg 1997; Huang BY et al. Radiol Clin N Am 2003)



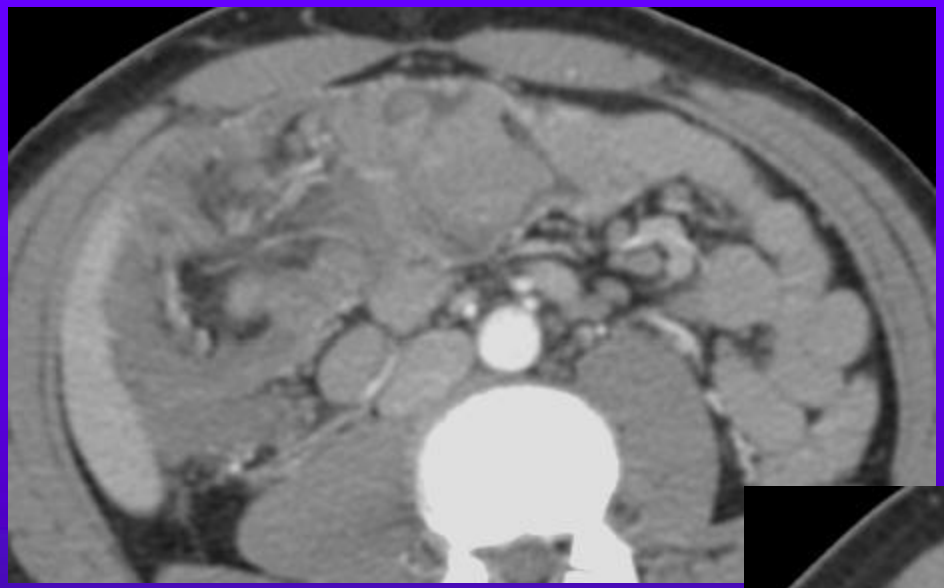
Intussusception in Adults

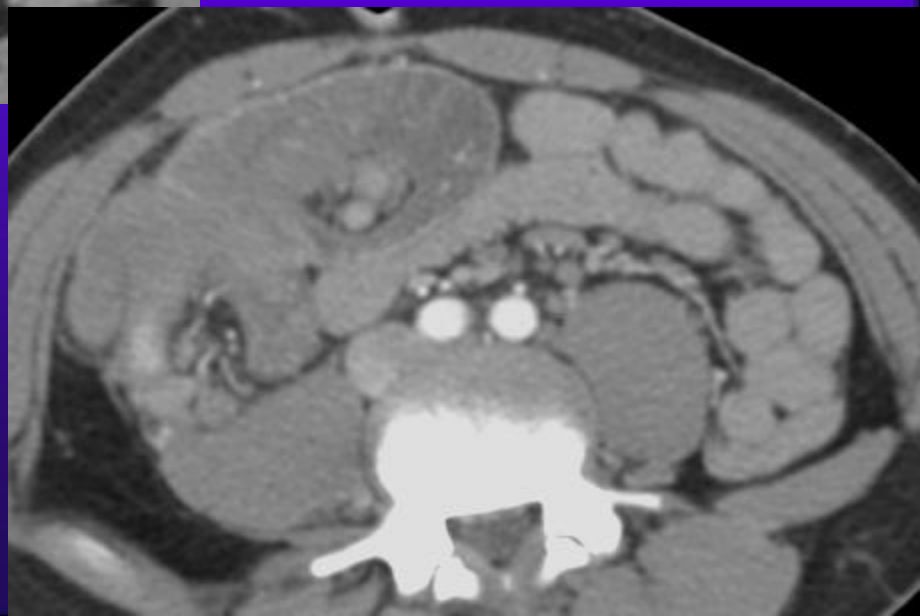
- Mayo Clinic series – 1978 to 2013 – intussusception in 318 adults (Amr MA et al. Am J Surg 2015):
- - 72% underwent CT; overall sensitivity of CT > 85%
- - lead point identified in 69%; malignancy present in 40%, 60% underwent surgery
- In general, need surgery if: palpable mass, obstruction, GI bleed, or leading point on CT (Onkendi EO et al. J Gastrointest Surg 2011; Varban OA et al. World J Surg 2013)

26-year-old woman with abdominal pain

- Colonic intussusception on non-contrast CT, due to underlying colonic adenocarcinoma

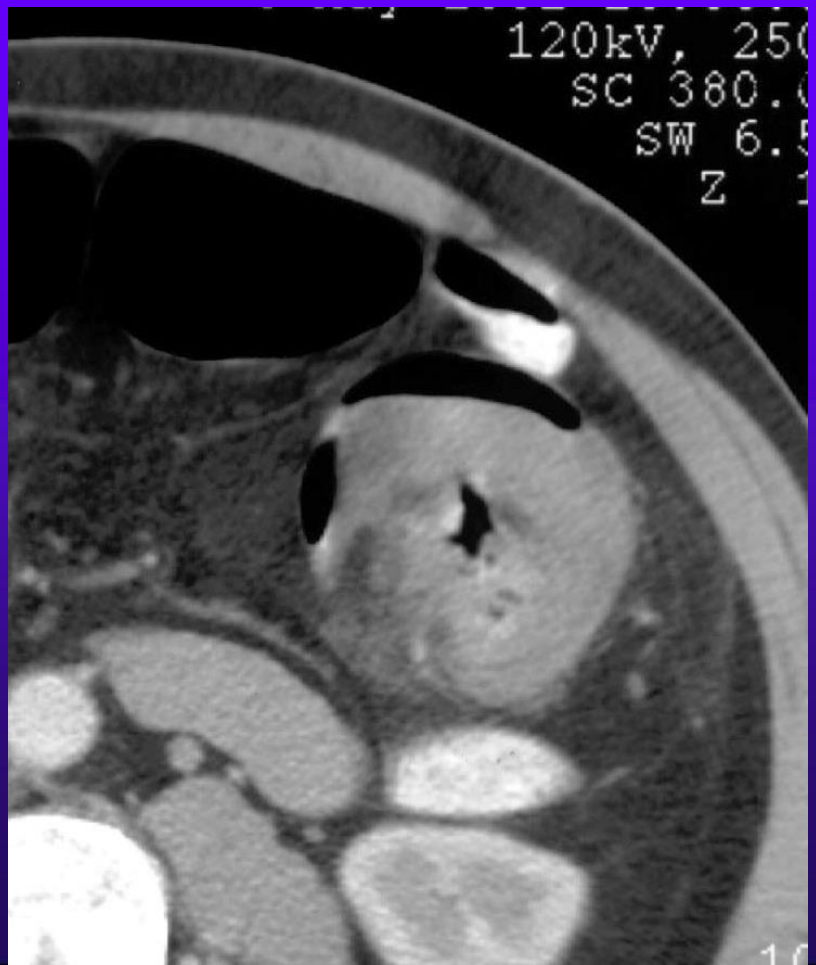
12-year-old male with abdominal pain – new diagnosis of lymphoma



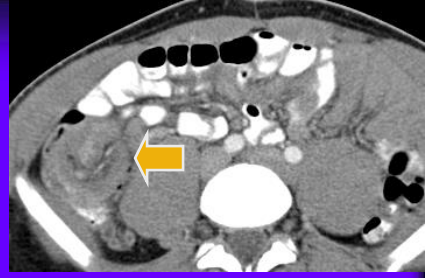


55-year-old man with left abdominal pain & lower GI bleed

- Intussusception due to a colonic lipoma



Intussusception in Adults

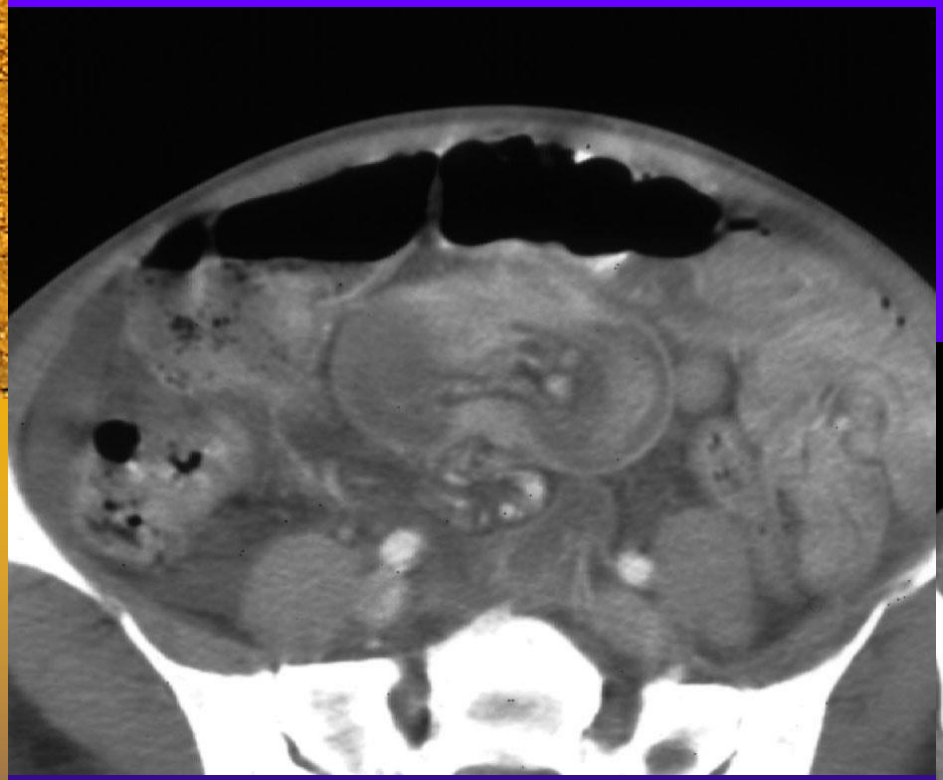


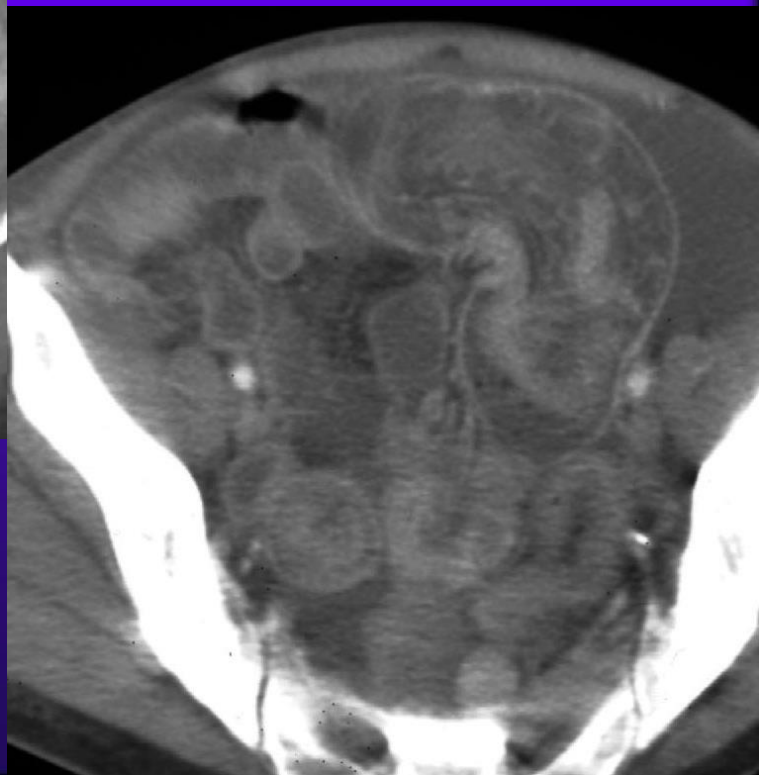
- Surgical intervention needed in all colonic cases regardless of etiology (no role for B.E.)
- CT findings (colonic involvement):
- - target or sausage-shaped mass
- - central portion is intussuscepted bowel loop (intussusceptum), surrounded by eccentrically-located fat, & then the intussuscipiens
- - may I.D. underlying mass, e.g. lipoma, appendiceal mucocele, or may be difficult to distinguish from edematous bowel
- Isolated small bowel intussusception:
- - ddx: benign (e.g. polyp) & malignant (e.g. melanoma metastases) leading points, but these are rare

Intussusception in Adults

- *- vast majority are transient*, with short segment (3.5-4 cm or less) & non-obstructive, without underlying mass; manage conservatively (Warshauer DM et al. Radiology 1999; Lvoff N et al. Radiology 2003; Horton KM et al. AJR 2008; Sandrasegaran K et al. Abdom Imaging 2004)
- - transient in celiac disease & Crohn disease
- - no consensus on follow-up testing (Kim YH et al. RadioGraphics 2006)
- - if longer segment or diameter, & when vascular compromise &/or inflammatory changes, consider more aggressive management (Tresoldi S et al. Abdom Imag 2008; Park SB et al. Eur J Radiol 2007) – but many non-surgical enteroenteric intuss. are longer than 3.5 cm & thicker than 3 cm (Sundaram B et al. AJR 2009)

41-year-old woman with metastatic melanoma

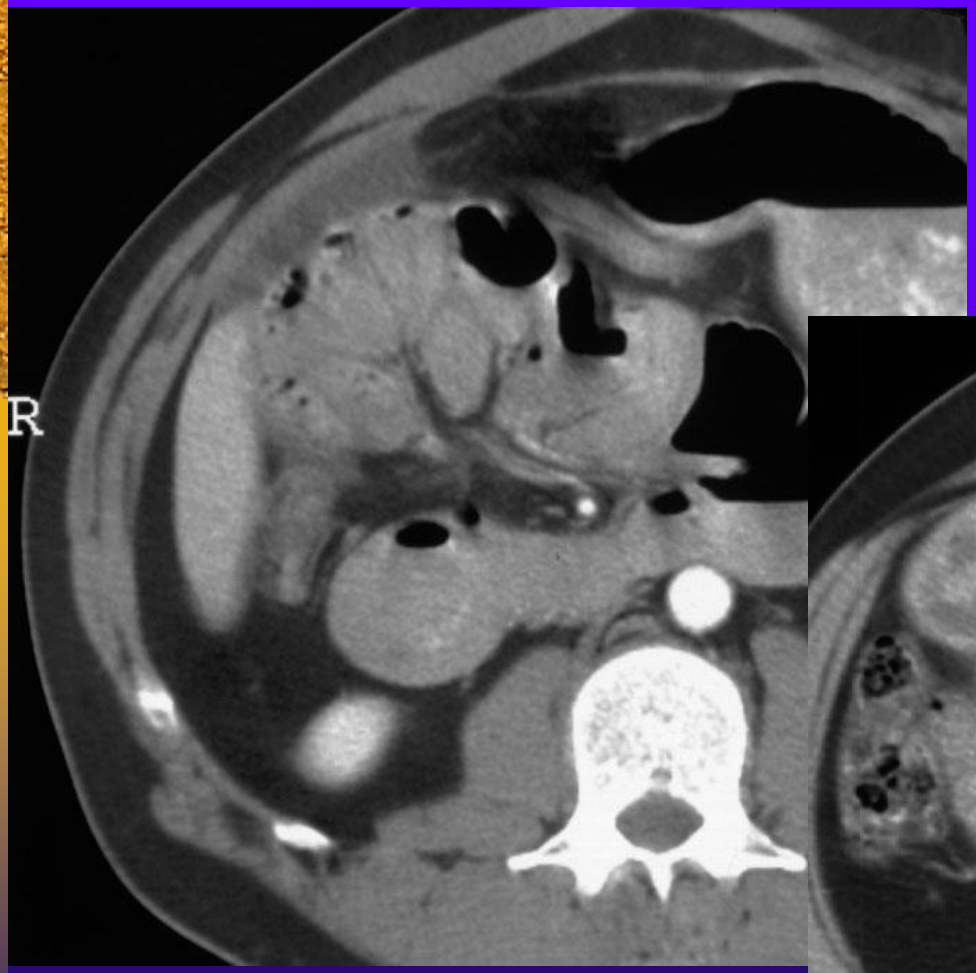




SBO from Internal Hernia

- Cause of SBO in 5% or fewer of all cases; related to congenital mesenteric defects or post-surgical (Zissin R et al. Br J Radiol 2005; Martin LC et al. AJR 2006)
- Presentation - from asymptomatic to intermittent symptoms to acute SBO with strangulation; need high index of suspicion, as CT findings may be subtle, particularly without SBO, and there is still a substantial FN rate (Gunabushanam G et al. JCAT 2009; Altieri MS et al. Surg Obes Relat Dis 2015; Park J et al. Hernia 2016)
- Distinction from closed loop SBO (due to adhesions &/or hernia) may be difficult – but management is the same: emergency surgery
- Paraduodenal – 53%; pericecal – 13%; foramen of Winslow – 8%; transmesenteric – 8% (Takeyama N et al. Radiographics 2005; Hongo N et al. Abdom Imag 2010)

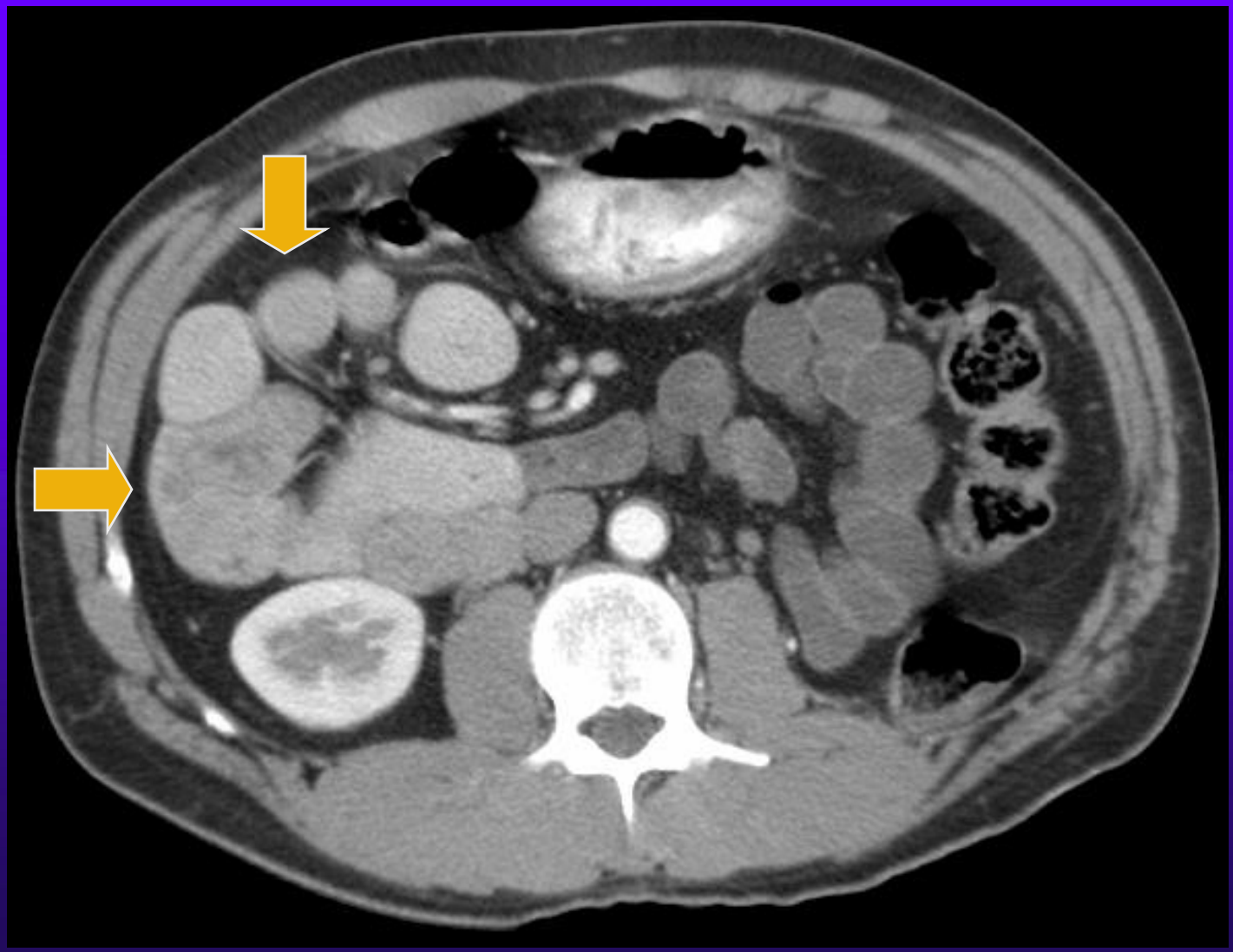
45-year-old man with right upper quadrant pain



SBO from Internal Hernia

- Left paraduodenal – “fossa of Landzert”; right – “fossa of Waldeyer”
- 75% on the left; clustered, sac-like dilated SB loops between pancreas & stomach
- Right paraduodenal – SB loops behind SMA & inferior to third portion of duodenum
- Foramen of Winslow hernias: from large foramina + long SB mesentery
- - similar appearance to left paraduodenal hernias – dilated SB in lesser sac although no encapsulating membrane; displaces stomach

50-year-old man with RUQ pain & vomiting – right paraduodenal hernia



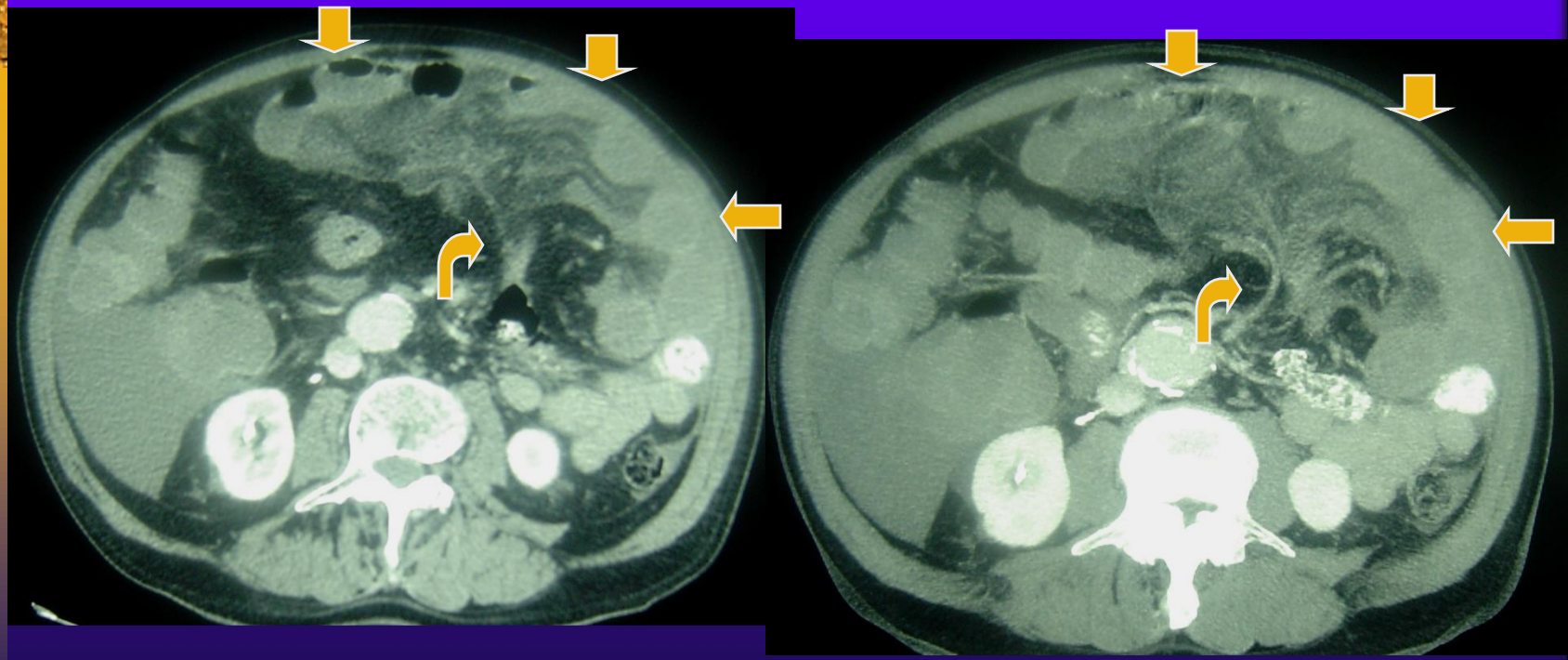
41-year-old man with abdominal pain and vomiting

SBO from Internal Hernia

- Transmesenteric hernias – complication after Roux-en-Y anastomosis, for liver transplantation or obesity surgery (Blachar A et al. Radiology 2001 & 2002; Merkle EM et al. Radiology 2005)
- Transmesenteric hernia s/p gastric bypass: Roux limb herniates through transverse mesocolon; no hernia sac in contrast to paraduodenal hernias
- Petersen hernia: small bowel herniates behind the Roux loop
- Rapid weight loss may predispose to enlargement of mesenteric defects; surgeons are now closing such defects prospectively at initial surgery, with subsequent decrease in internal hernias as a result (Yu J et al. Radiology 2004; Obeid A et al. J Gastrointest Surg 2014)

Transmesenteric hernia in a male patient with no prior surgical history

- Case courtesy Dr. Bruce Javors



SBO from Internal Hernia

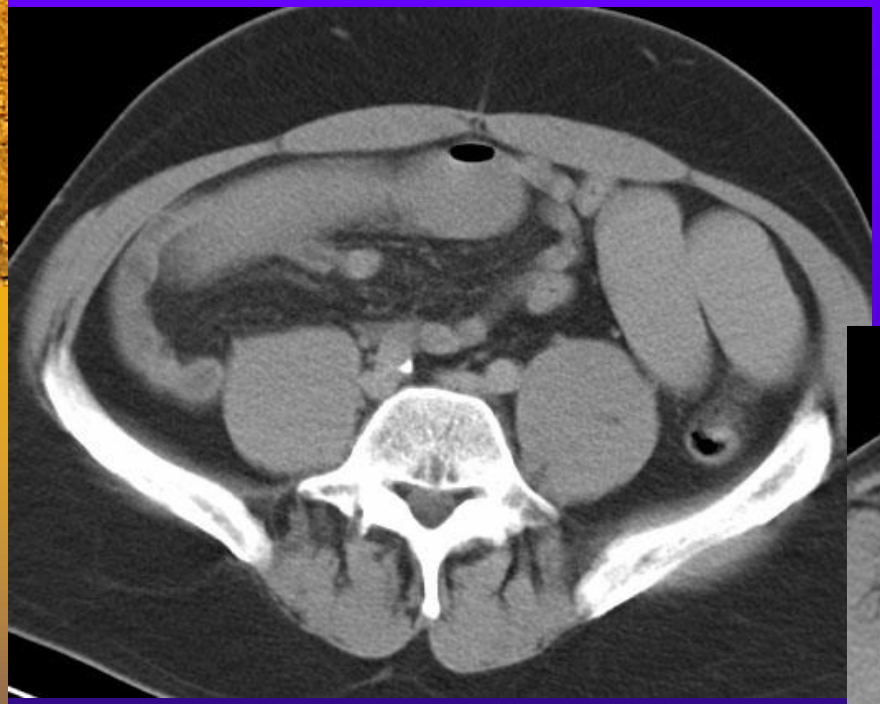
- CT findings of transmesenteric hernia s/p liver transplantation: reversal of normal arrangement of bowel – central colon, peripheral small bowel, stretching of mesenteric vascular pedicle, with SBO (Blachar A et al. Radiology 2001; Hong SS et al. JCAT 2005)
- CT findings s/p gastric bypass – clustered dilated small bowel in left upper quadrant or midline (Blachar A et al. Radiology 2002)
- Multiple CT criteria with varying sensitivity & specificity; use in combination (Lockhart ME et al. AJR 2007; Reddy SA et al. AJR 2007; Iannuccilli JD et al. Clin Radiol 2009; Park J et al. Hernia 2016) – in the first of these series (mostly with Petersen hernias), swirling of bowel/mesentery + mushroom shape of mesentery was most predictive

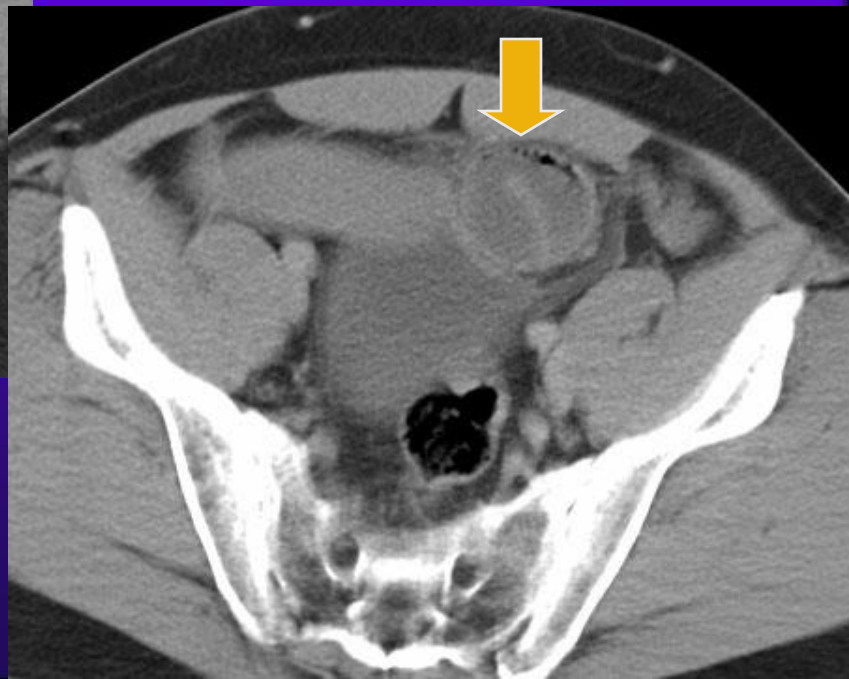
SBO from Internal Hernia

- Large series of internal hernias after gastric bypass surgery (Garza E et al. Am J Surg 2004):
- 1000 consecutive laparoscopic retrocolic Roux-en-Y gastric bypass surgeries
- 45 internal hernias in 43 patients; 43 transmesenteric & 2 Petersen
- Mean time from surgery to diagnosis of 225 days (2 to 490)
- 86% had CT prior to diagnosis, but the specific diagnosis was established prospectively based on CT in only 64% of cases (22/34)

Physician with severe LLQ pain following vigorous bicycle ride

- Case courtesy Dr. Maher Abbas, Los Angeles, CA





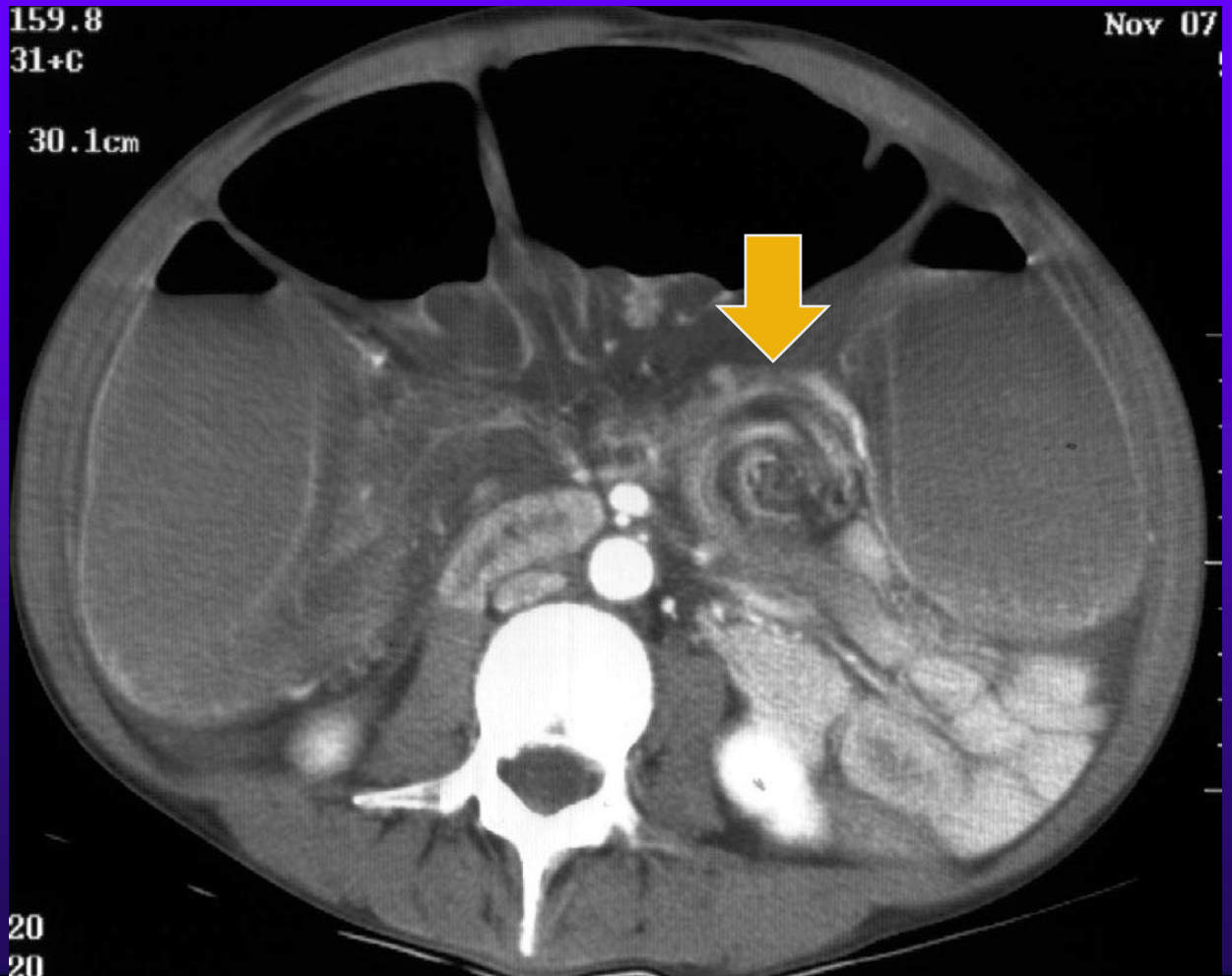
Cecal Volvulus

- Colonic volvulus: causes up to 10% of large bowel obstruction
- Predisposing long mesentery (in up to ¼ individuals); an adhesion may also serve as a fulcrum for rotation
- Sigmoid volvulus is the most common type
- Untreated volvulus may be fatal
- Cecal volvulus needs emergent surgery
- Surprisingly few CT reports – some of the largest series include only 10 and 11 cases (Delabrousse E et al. Emerg Radiol 2007; Rosenblat JM et al. Radiology 2010)

Cecal Volvulus

- Radiographs may show the classic "coffee-bean appearance" - dilated, inverted U-shaped formation – but are equivocal in up to 1/3 of cases; distal colon is usually decompressed
- Need to recognize CT findings – may be first test performed or may follow equivocal radiographs (Moore CJ et al. AJR 2001, Rosenblat JM et al., Delabrousse E et al.; Heller MT et al. Emerg Radiol 2014): obstruction, torsion of colon around mesocolon with "whirl sign"
- - tapered narrowing of efferent & afferent loops
- - "coffee-bean" appearance may be seen
- - additional more recent signs: x-marks-the-spot sign, split wall sign, etc.
- - bascule – distended cecum is folded on itself

34-year-old woman with anorexia/laxative abuse, now severe abdominal pain

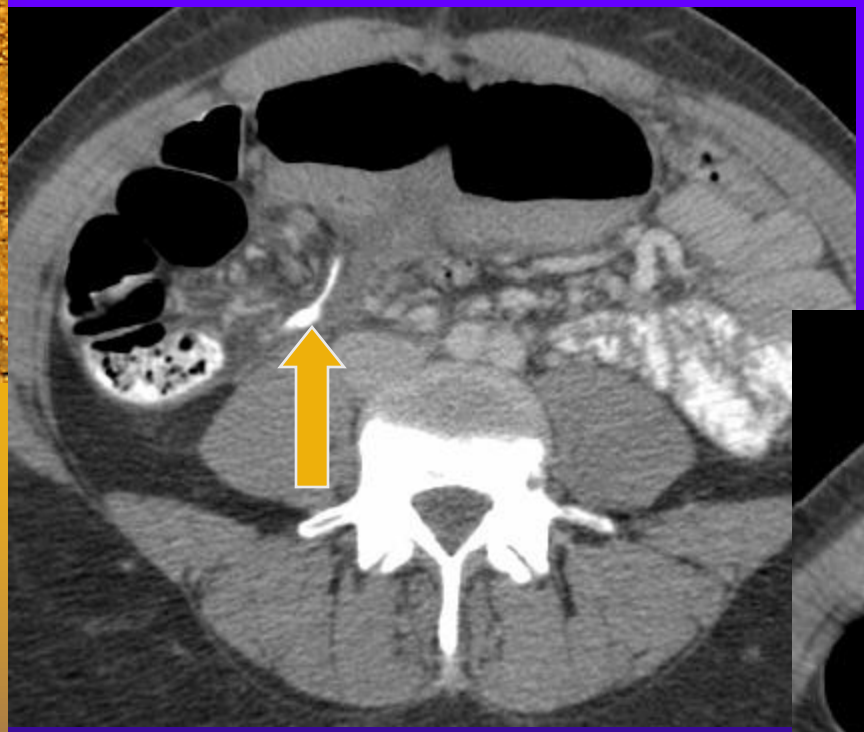


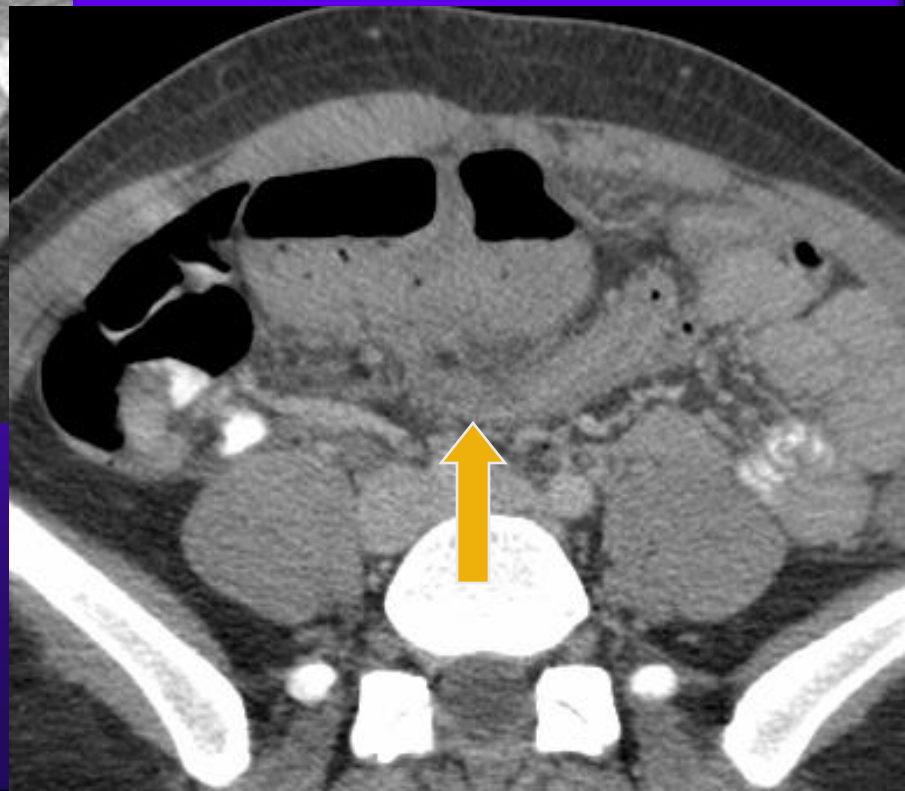
40-year-old woman with free air on initial radiographs

Cecal Volvulus

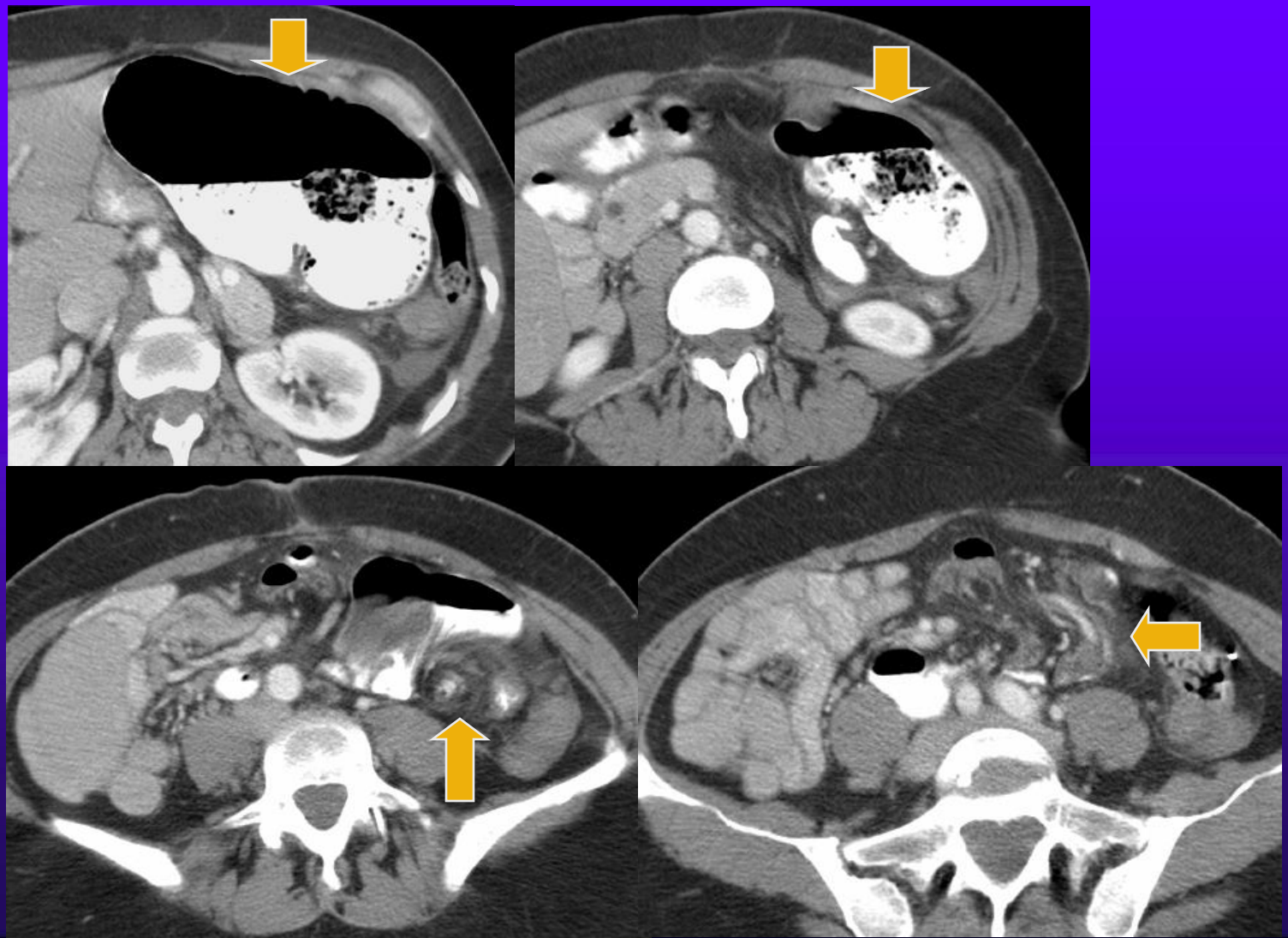
- - cecum is usually markedly dilated, although it may not be obvious that the dilated portion of bowel is the cecum
- - ½ cases, cecum twists in axial plane & remains in RLQ (axial type, with clockwise whirl); in other ½ cases, cecum twists & inverts (loop type, counterclockwise whirl), migrates to LUQ
- - in series of 11 cases c/w 12 controls, whirl sign & 'transition points' had 73% & 82% sensitivity, & 100% specificity (Rosenblat JM et al. Radiology 2010)
- - multiplanar reformations may be helpful
- - if strangulation: mesenteric edema, bowel thickening, & pneumatosis

21-year-old woman, acute pain





48-year-old woman, vomiting & acute LLQ pain



Intramural Small Bowel Hemorrhage

- Intramural (usually submucosal) small bowel hemorrhage (ISBH): relatively rare, but likely under-diagnosed
- Related to anticoagulation or underlying bleeding disorder in adults; also secondary to ischemia or closed loop obstruction, as well as aortoenteric fistula, vasculitis, & iatrogenic causes
- Correct diagnosis is often unsuspected & delayed
- Vague, subacute symptoms are common – may be asymptomatic with decrease in hematocrit only; GI bleeding in 50% or fewer (Abdel Samie E et al. 2012 Expert Rev Gastroenterol Hepatol)

Intramural Small Bowel Hemorrhage

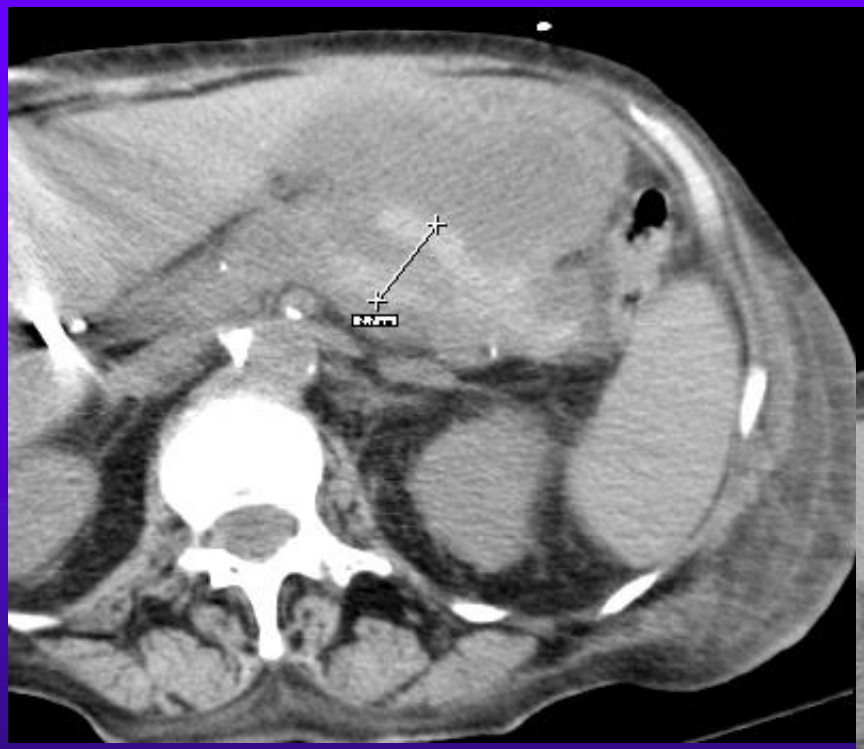
- CT findings best seen on non-enhanced CT; IV & oral contrast may obscure the specific diagnosis (Lane MJ et al. Clin Radiol 1997; Abbas MA et al. Arch Surg 2002; Macari M et al. AJR 2003):
- - hyperdense SB wall thickening, homogeneous and symmetric
- - usually duodenum/proximal jejunum
- - usually single site
- - average length variable

Intramural Small Bowel Hemorrhage

- Hemorrhage complicating ischemia/complicated SBO is likely under-diagnosed
- Focal ISBH complicating SBO indicated complicating ischemia (present in 19/45 patients) – 100% specific, 56% sensitive (Geffroy Y et al. Radiology 2014)
- Most accurate MDCT sign for ischemia in this series was: decreased small bowel wall enhancement - sensitivity: 78%, specificity: 98%

64-y.o. man with abdominal pain, on coumadin

76-y.o. woman with abdominal pain, also on coumadin



Intramural Small Bowel Hemorrhage

- Patients usually managed conservatively, although rarely will need surgery due to obstruction (Cheng J et al. Acta Gastroenterol Belg 2008; Carkman S et al. Ulus Travma Acil Cerrahi Derg 2010)
- Prognosis guarded if >1/2 length of small bowel is involved
- Repeat CT shows resolution as early as within one week
- Rarely may extend from small bowel into cecum

Esophageal Intramural Hematoma and Boerhaave's

- Esophageal perforation – iatrogenic & non-iatrogenic causes; first described in 1724
- Iatrogenic – 75%; s/p dilatation, endoscopy, NGT, ETT, & post-surgical
- Non-iatrogenic – post-emetic, post-inflammatory, post-infectious, & neoplastic
- Post-emetic – following excessive food/alcohol intake:
- - mucosal injury at esophagogastric junction, with hemorrhage: associated with a Mallory-Weiss tear
- - if transmural tear, Boerhaave's syndrome, with perforation into mediastinum

Esophageal Intramural Hematoma and Boerhaave's

- - most commonly on the left side posterolaterally; may simulate aortic dissection, MI, etc., clinically
- Although radiographs may show evidence of perforation – with subsequent confirmation on esophagram – diagnosis can be established on CT, both when the diagnosis is suspected & when it is not (Fadoo F et al. AJR 2004; Ghanem N et al. Emerg Radiol 2003; Restrepo CS et al. Emerg Radiol 2008)
- CT findings:
- - pneumomediastinum or air-fluid levels in mediastinum/pleural space (especially on the left)

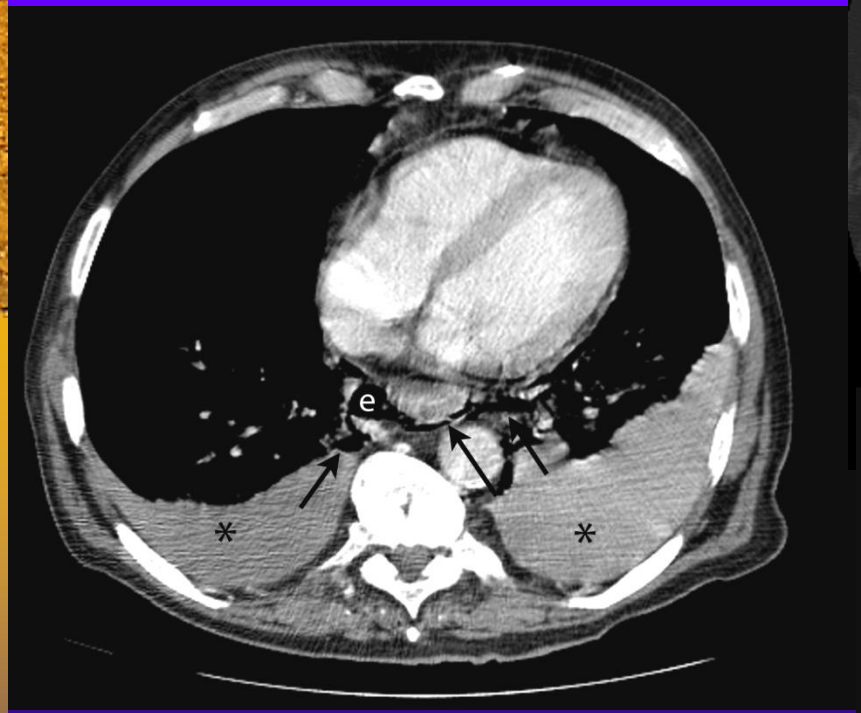
Esophageal Intramural Hematoma and Boerhaave's

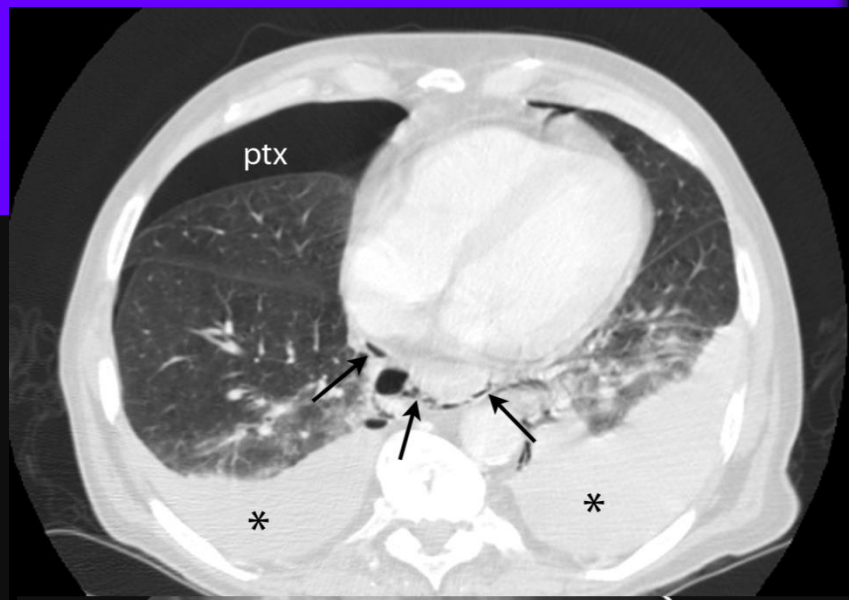
- - communication (air or water-soluble contrast) between esophagus & mediastinum
- - pericardial effusion
- - esophageal wall thickening
- Most submucosal hematomas are iatrogenic
- - some post-traumatic, or related to anticoagulation/bleeding disorders
- - CT demonstrates submucosal collection, attenuation c/w hemorrhage

39-year-old alcoholic woman with pain following vomiting

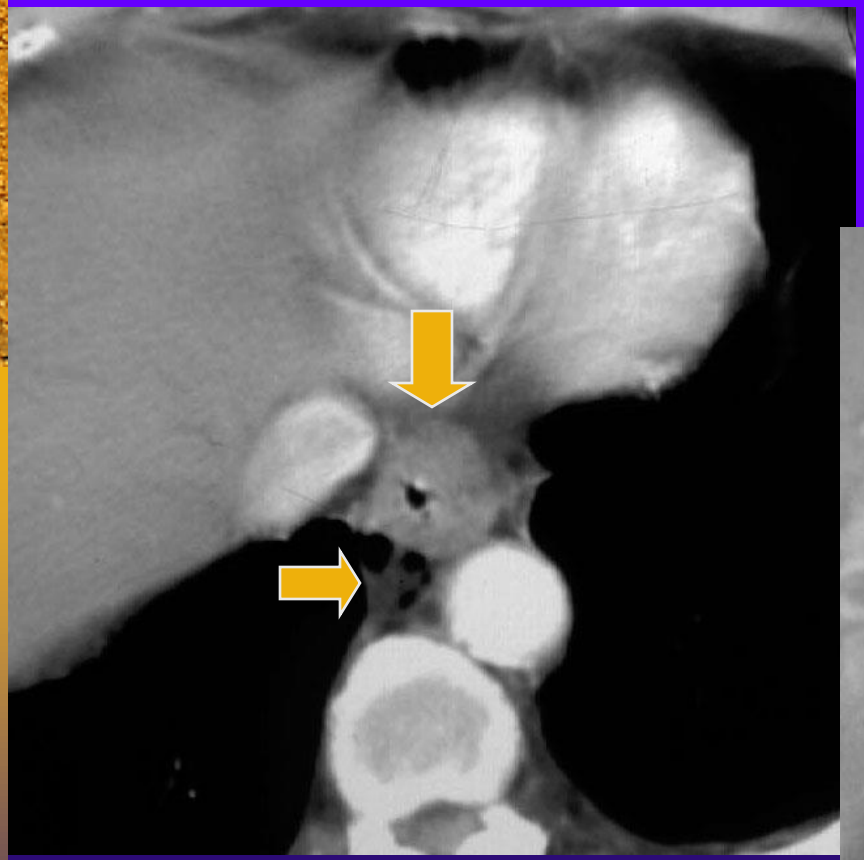
- Case Courtesy Dr. Gordon Smith, Birmingham, AL

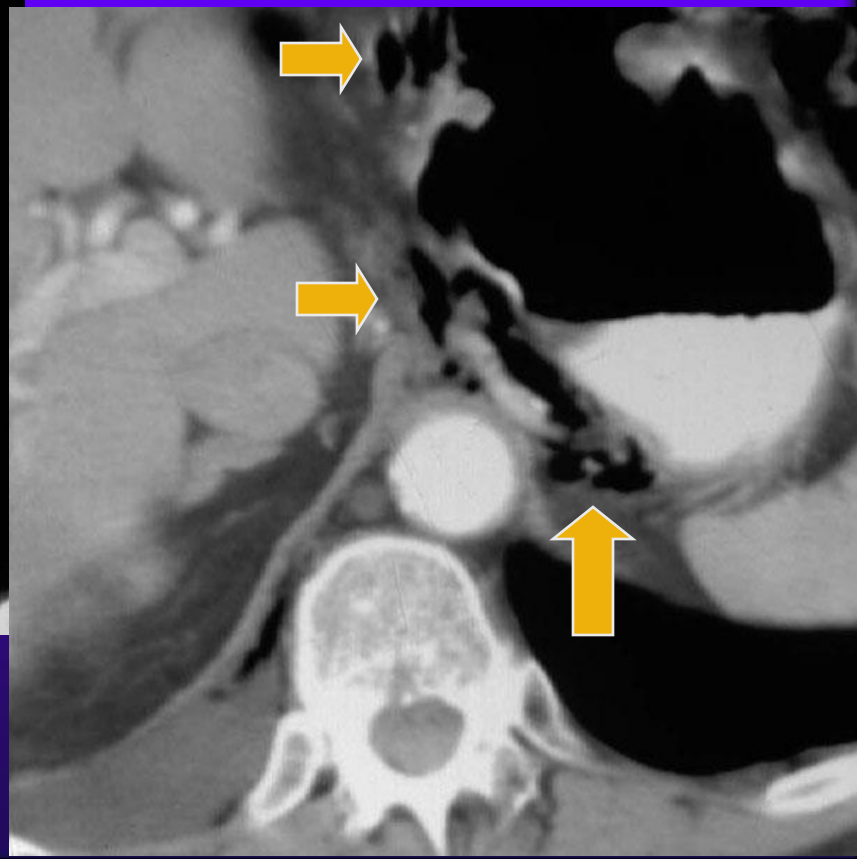
81-y.o. man with sudden onset of chest pain



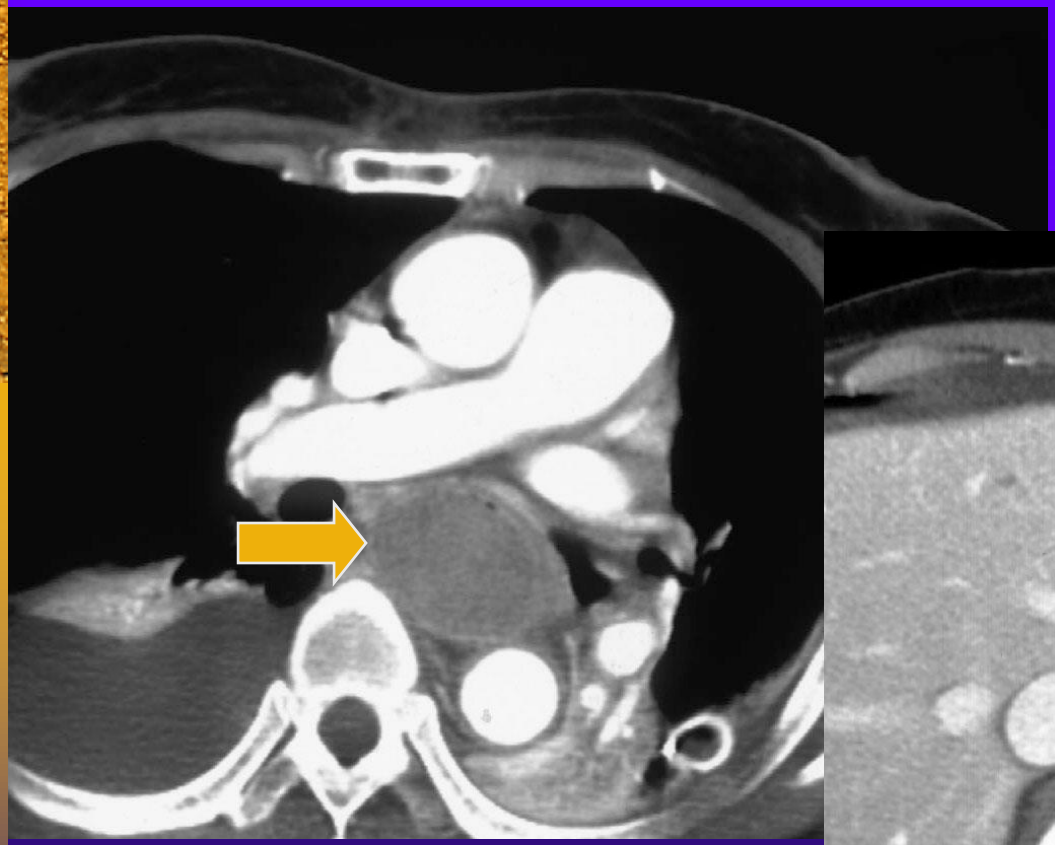


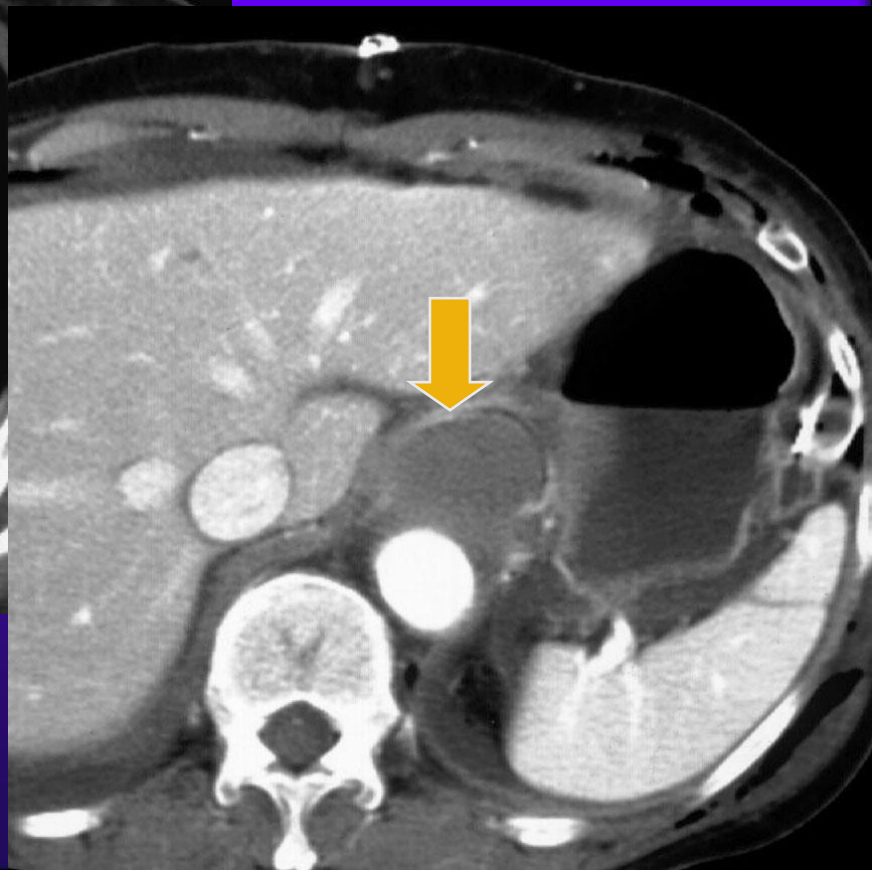
82-year-old man with retching and hiccups, then hematemesis





62-year-old woman with esophageal intramural hematoma





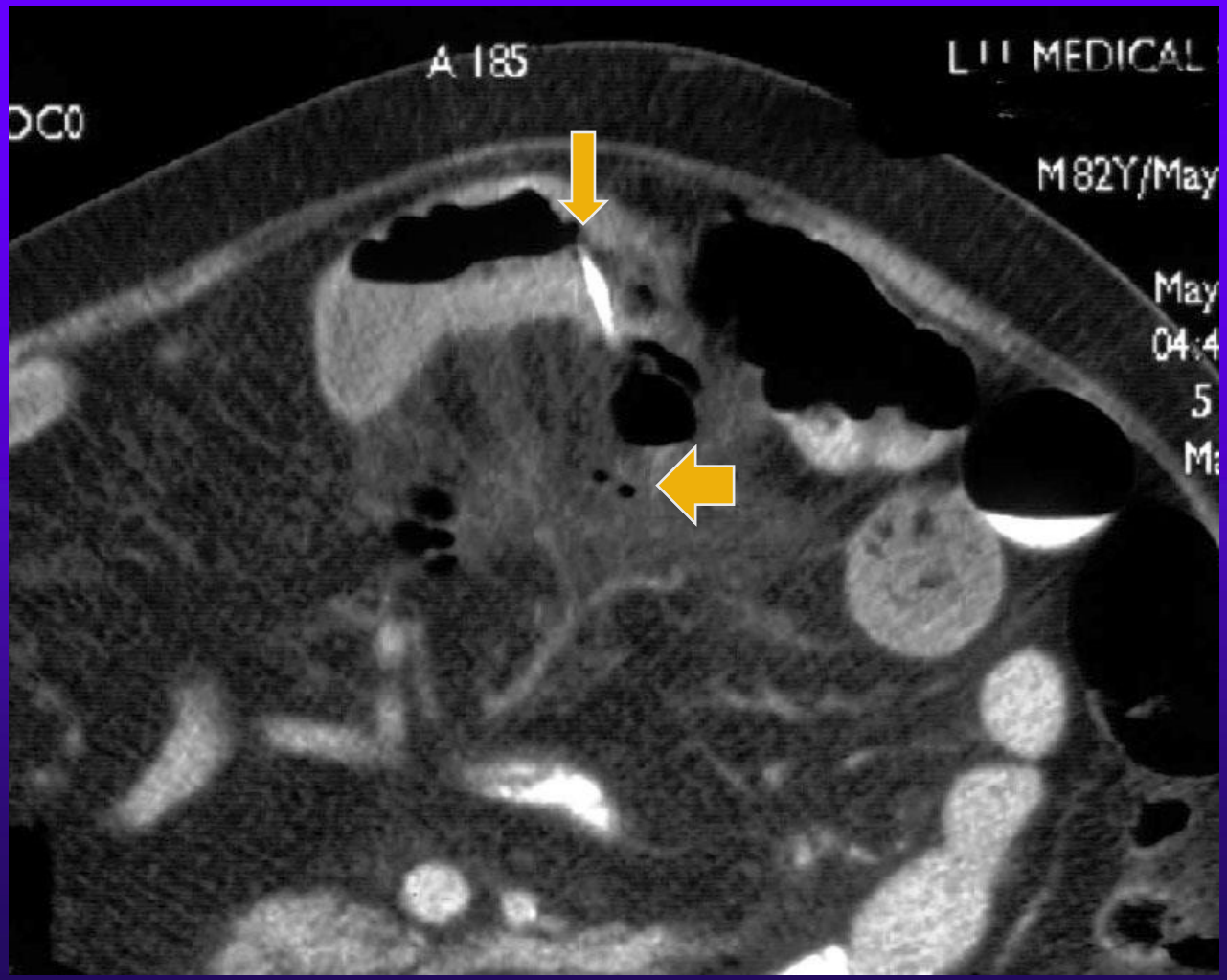
Esophageal Intramural Hematoma and Boerhaave's

- Esophageal intramural hematoma – usually managed conservatively (Yen HH et al. Gastrointest Endosc 2005)
- Emergent surgery for vast majority of cases of Boerhaave's (Vial CM et al. Surg Clin North Am 2005; Teh E et al. Interact Cardiovasc Thorac Surg 2007)
- Conservative management if combination of contained tear, minor symptoms, no pleural contamination, & no systemic infection

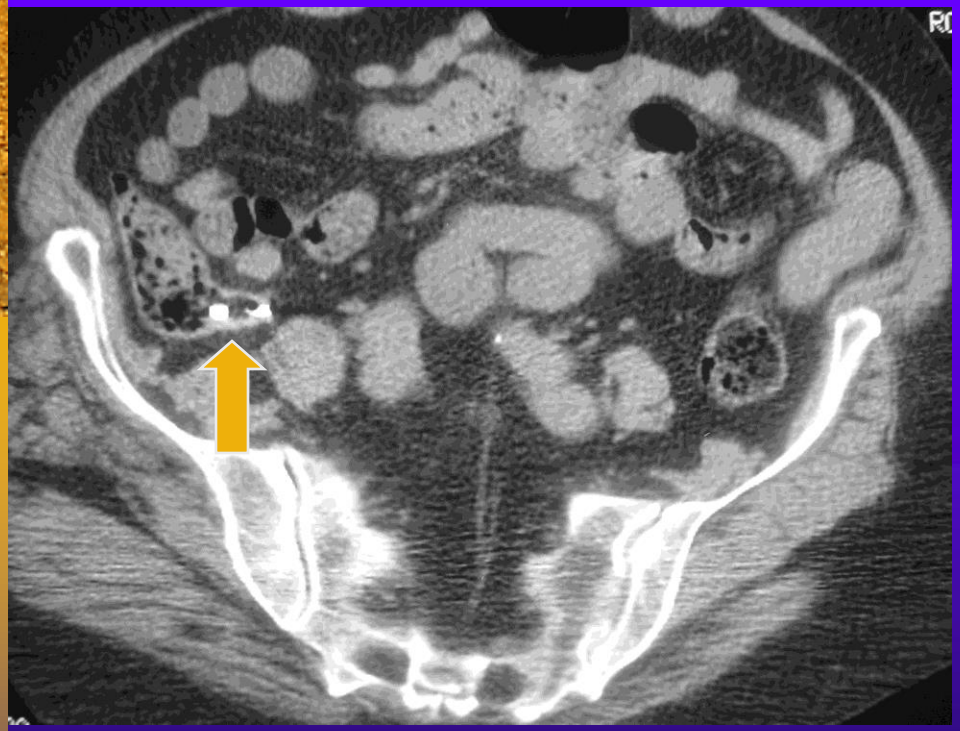
Luminal Foreign Bodies

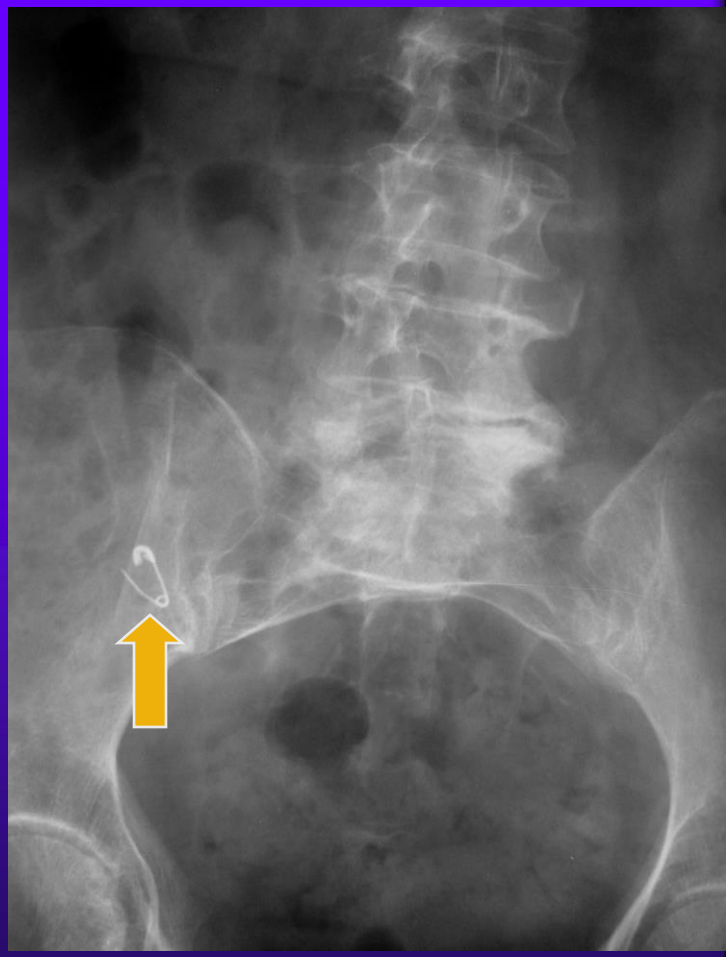
- Relatively few reports on CT, or on added utility c/w with radiographs (Furukawa A et al. Abdom Imaging 2005; Zissin R et al. Br J Radiol 2009; Coulier B et al. Eur Radiol 2004); mostly (numerous) case reports in the literature
- Most common in elderly, neurologically compromised, & alcoholics; occasionally in healthy adults (Williams C et al. Am Surg 2004)
- Long, hard, or sharp objects – fish & chicken bones, toothpicks, pins, etc. (Go B et al. AJR 2006)
- May have lag between swallowing & clinical presentation – *need high index of suspicion*
- Most foreign bodies (80-90%) pass without complication – but perforation may occur at any site; depends on size, configuration, & type

82-year-old man with abdominal pain after eating turkey



Open safety pin in the appendix

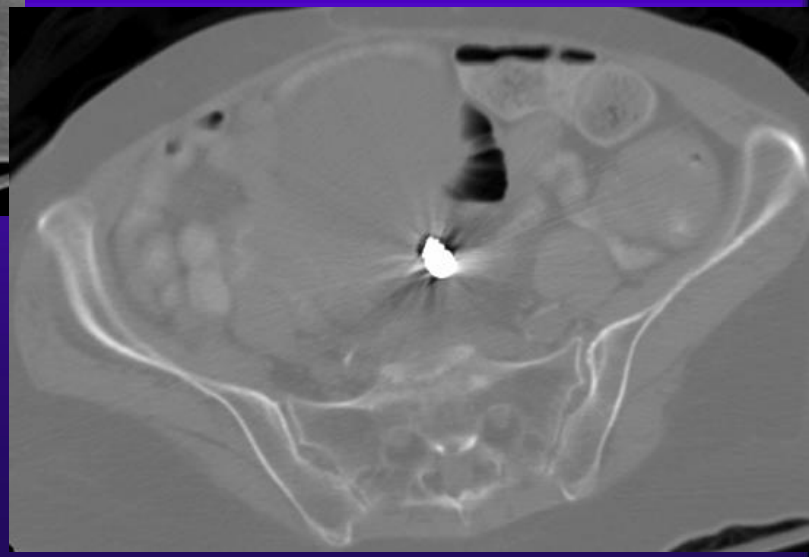




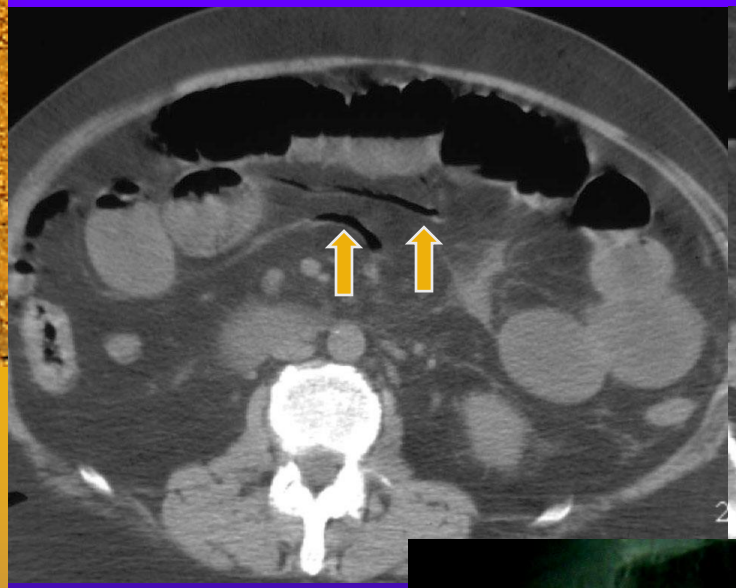
Luminal Foreign Bodies

- Most often perforate at normal or pathologic site of narrowing/angulation (e.g. appendix, t.i.)
- CT is usually diagnostic regardless of the density of the foreign body, *although may be subtle, especially fish bones/toothpicks; watch windows* (Gayer G et al. RCNA 2014; Pugmire BS et al. RG 2015)
- Local thickening, localized extraluminal gas, free air (unusual), pneumatosis, abscess, & other complications are demonstrated
- Capsular endoscope – retention in 14 out of 1000 cases (1.4%), in 11 due to NSAID enteropathy (Li F et al. Gastrointest Endosc 2008); also Crohn dx & tumors

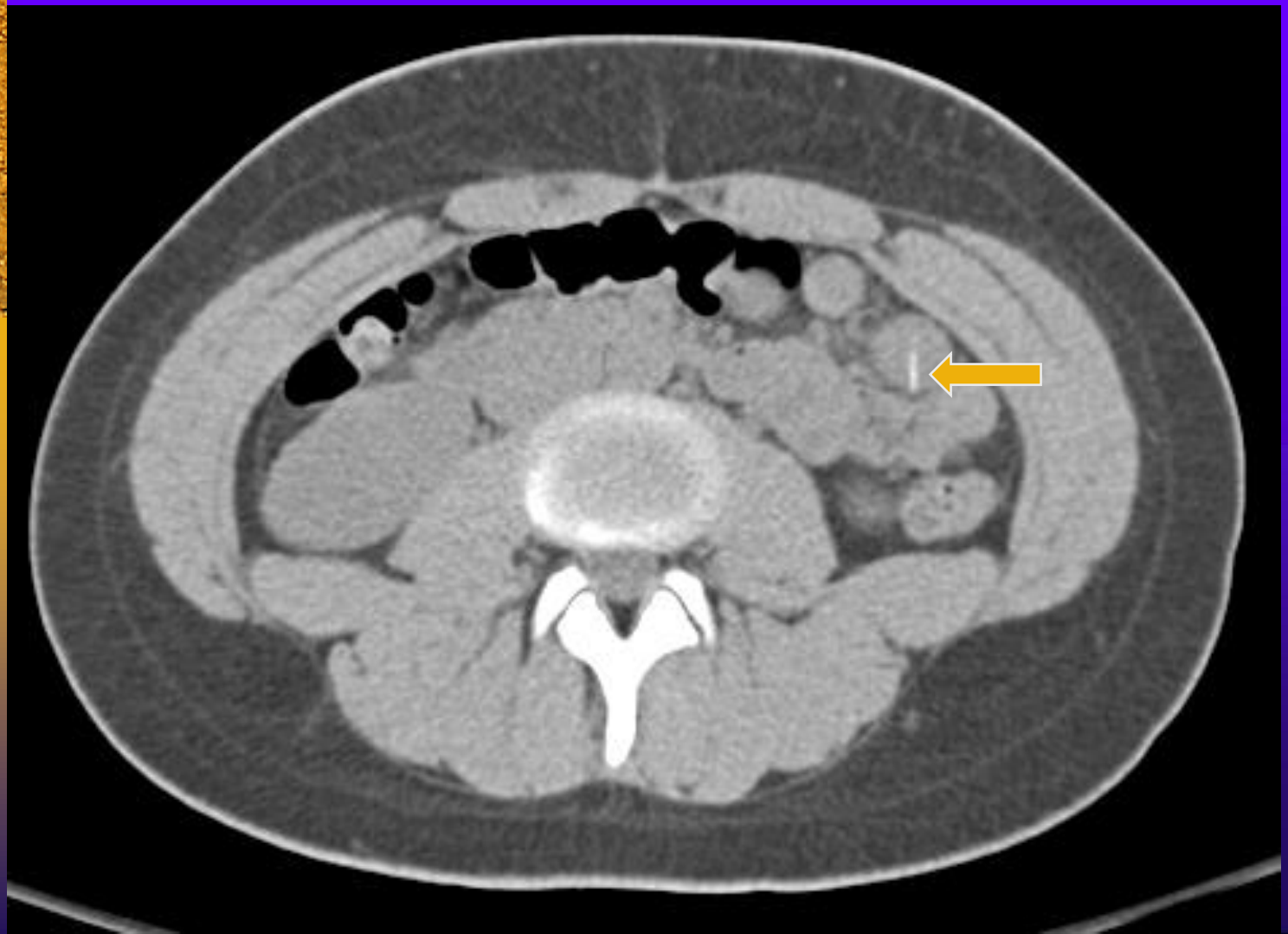
78-year-old woman with abdominal pain and vomiting s/p capsular endoscopy



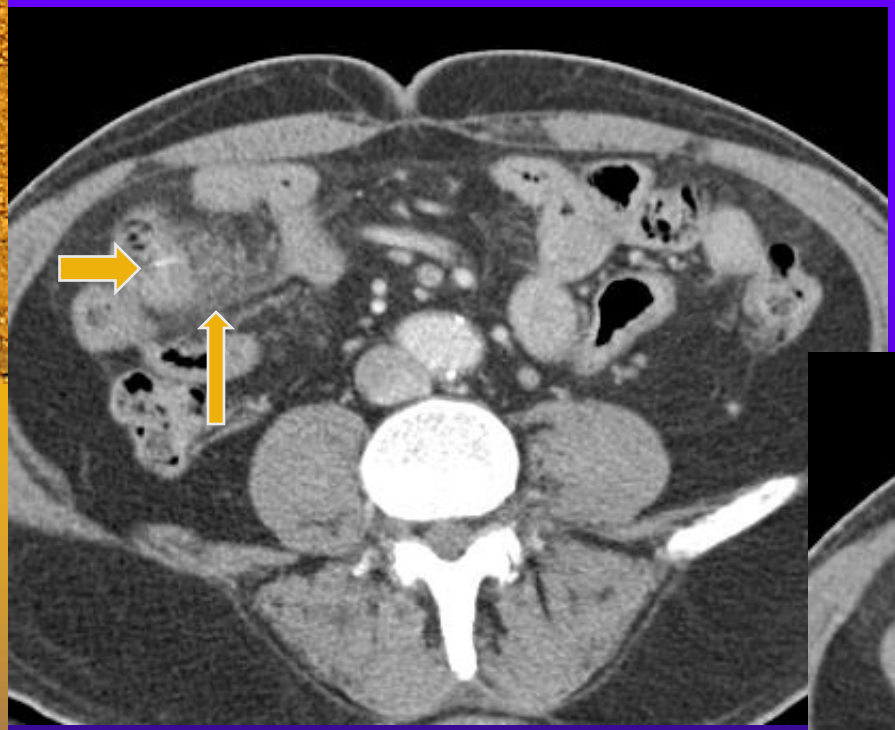
54-year-old man with neurologic compromise

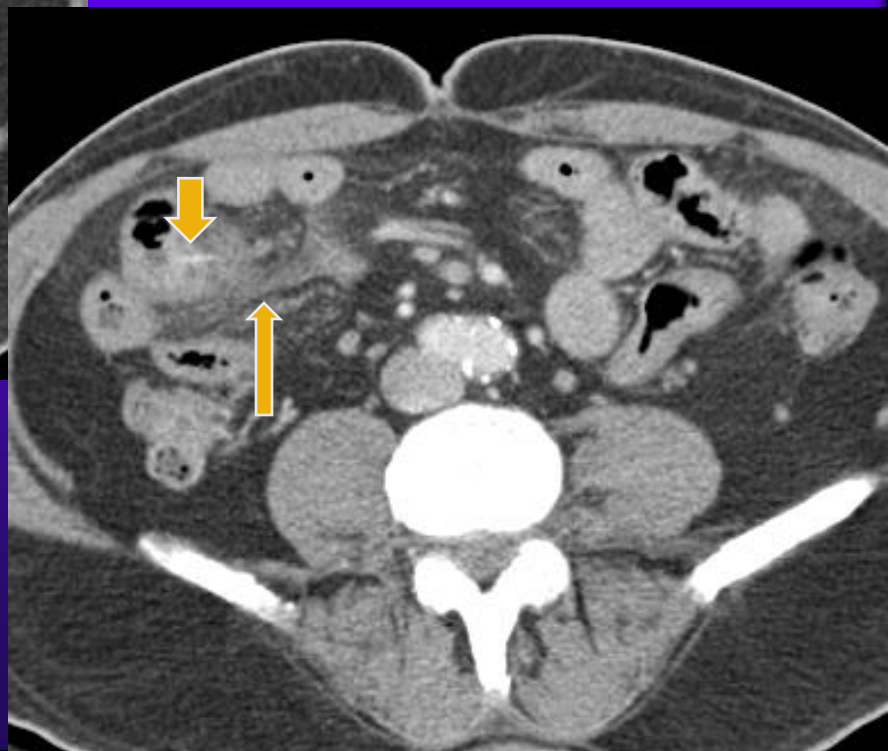


16-y.o. female with several days left flank pain, r/o stone

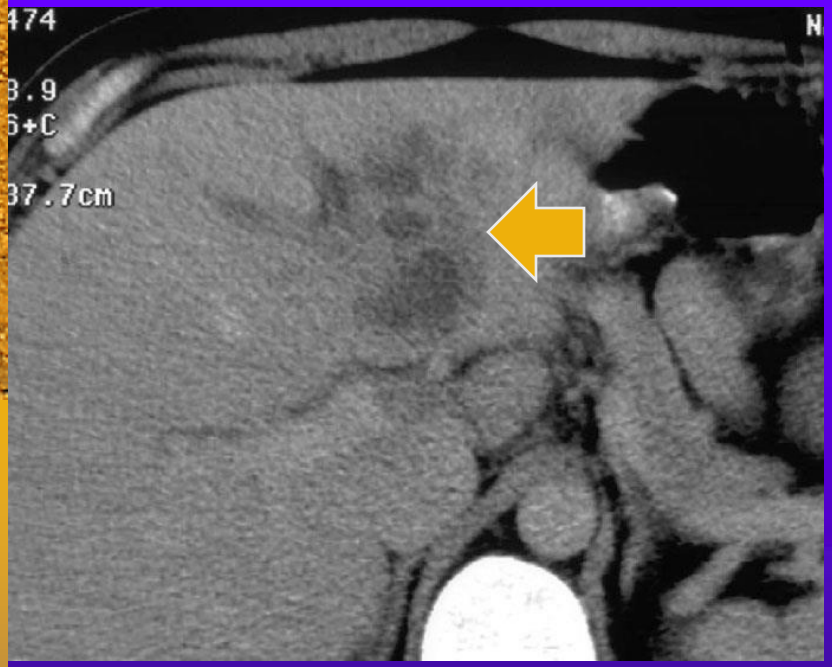


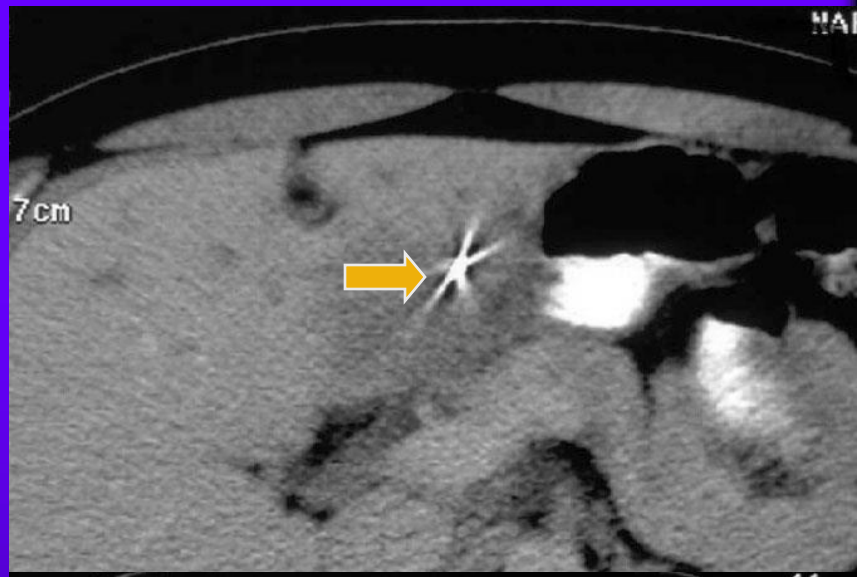
78-y.o. woman with right abdominal pain, r/o ischemia

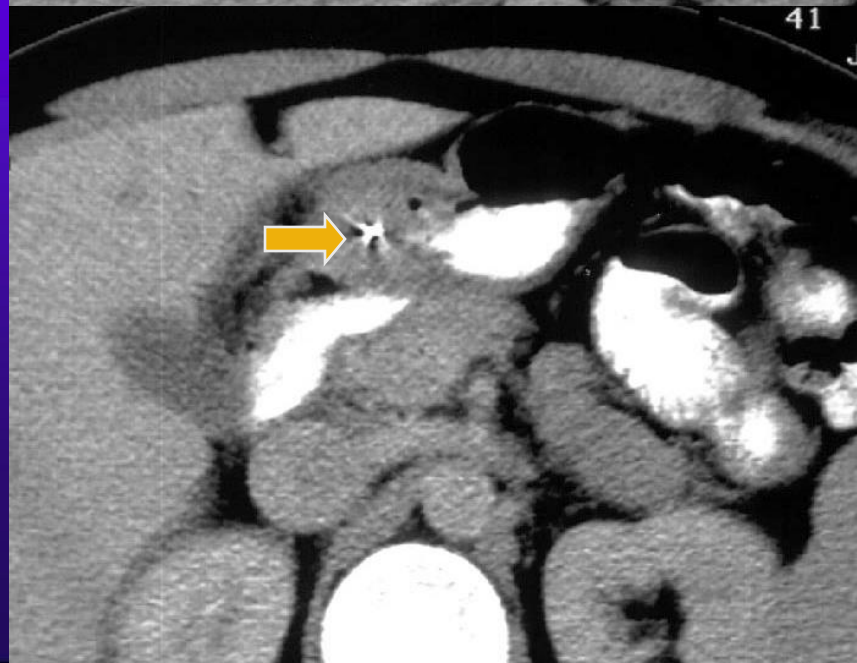




41-year-old man with RUQ pain and fever







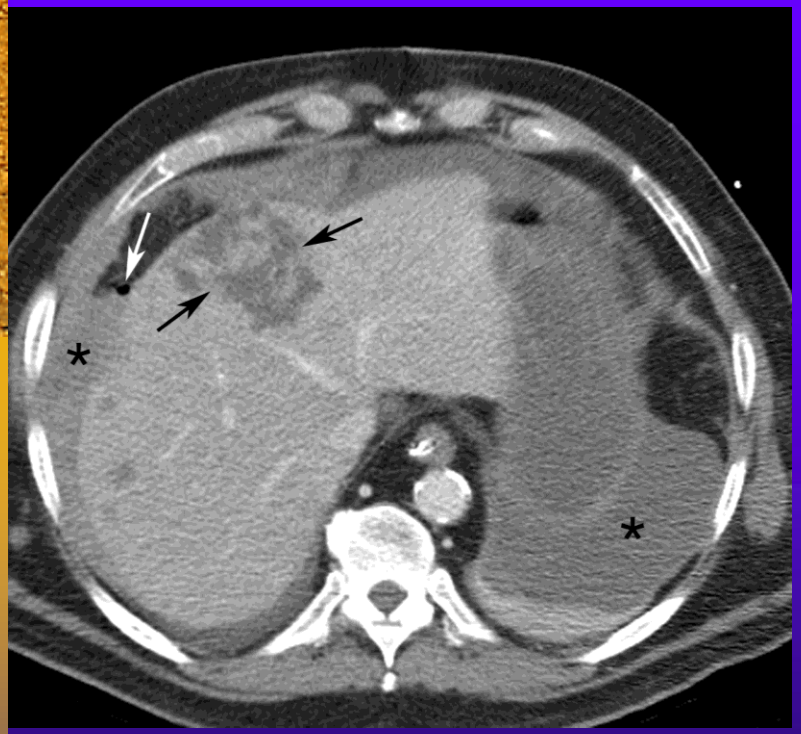
Hemorrhagic Tumors

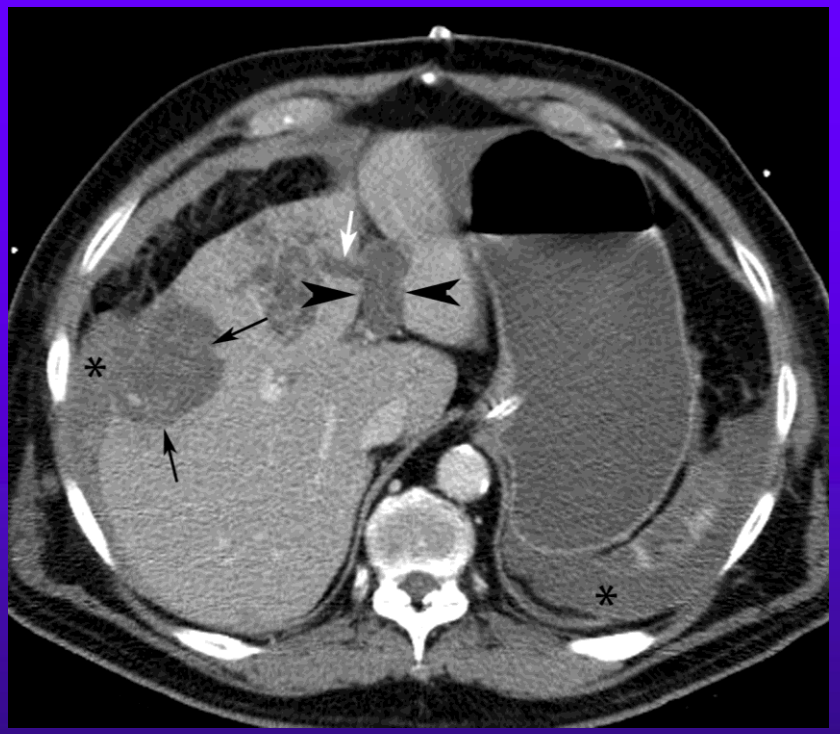
- Hemoperitoneum secondary to tumor is a very uncommon scenario in the U.S. (Lucey BC et al. Emerg Radiol 2007; Mortele KJ et al. Radiol Clin North Am 2007; Lubner M et al. RadioGraphics 2007)
- Identification of the underlying tumor at CT may be difficult, including in the liver, depending on size of tumor c/w the amount of hemorrhage
- Abdominal pain, signs of acute blood loss (hypotension, tachycardia); increasing abdominal girth, anemia, & peritonitis
- Spontaneous hepatic hemorrhage in a woman on birth control pills is highly suspicious for hepatic adenoma(s)

Hemorrhagic Tumors

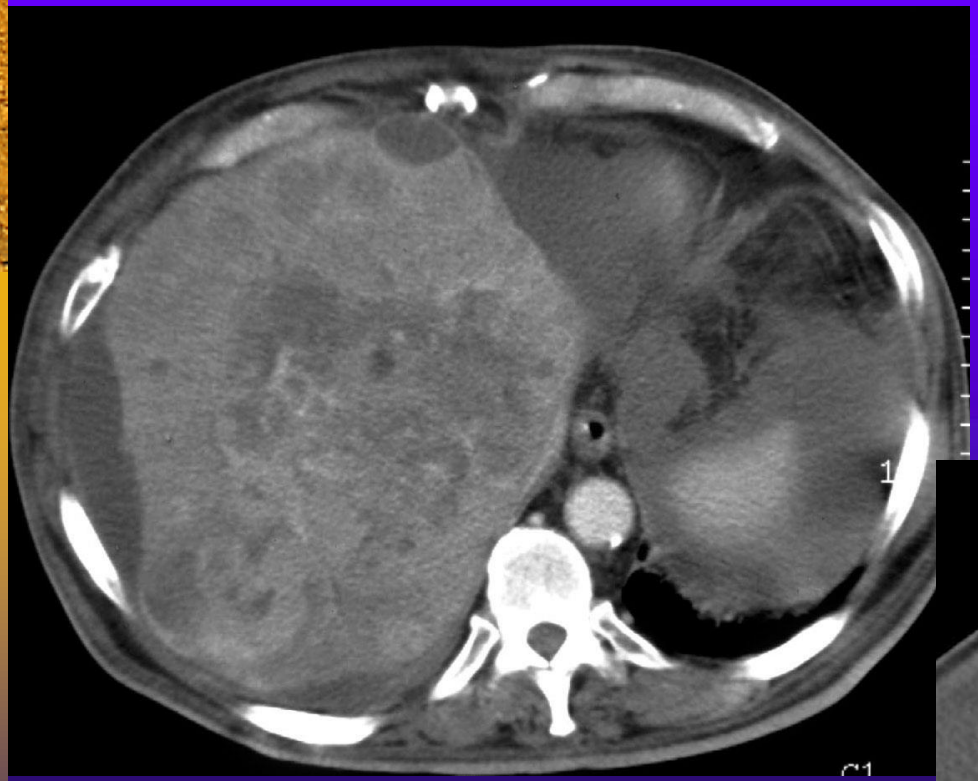
- Hemoperitoneum from hepatocellular carcinoma (HCC) is relatively common in Asia/Africa, but only 2% of U.S. patients with HCC present with capsular rupture
- Bleeding from HCC may occur at initial presentation
- HCC is highly vascular; tumor necrosis can lead to rupture of blood vessels penetrating the hepatic capsule (Kim PT et al. Can Assoc Radiol J 2006; Kim HC et al. Abdom Imaging 2008)
- Other hepatic or GI tract neoplasms rarely can present as hemoperitoneum, e.g. GISTs (Cegarra-Navarro MF et al. Abdom Imag 2005)

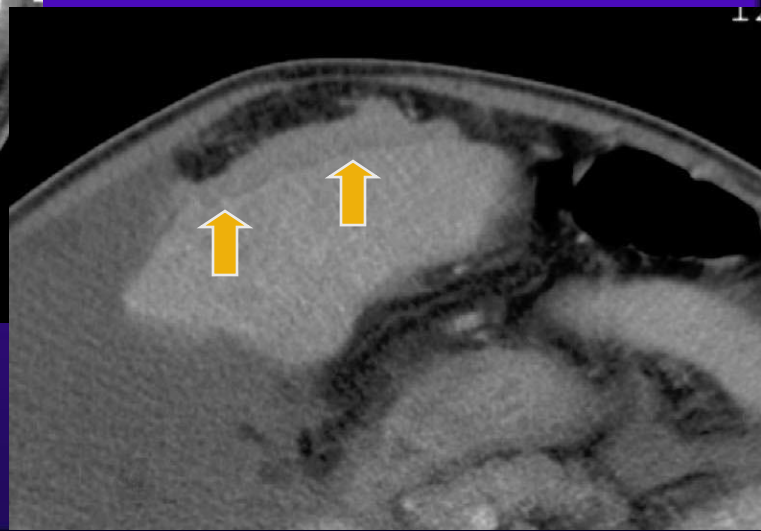
67-year-old man with severe acute abdominal pain, now s/p lap.





69-year-old man with cirrhosis and abdominal pain – acute hemorrhage from HCC

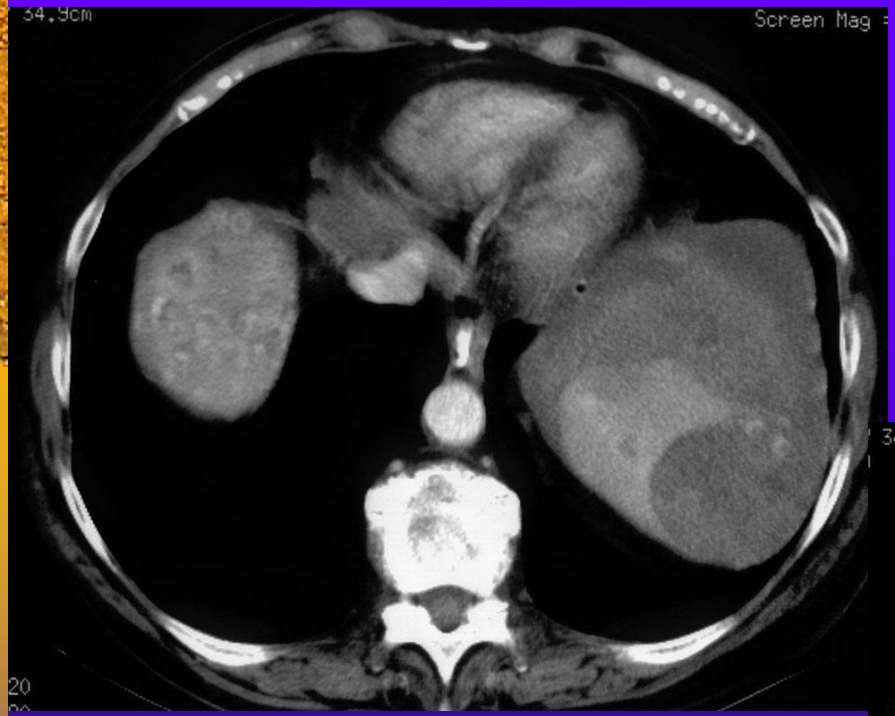


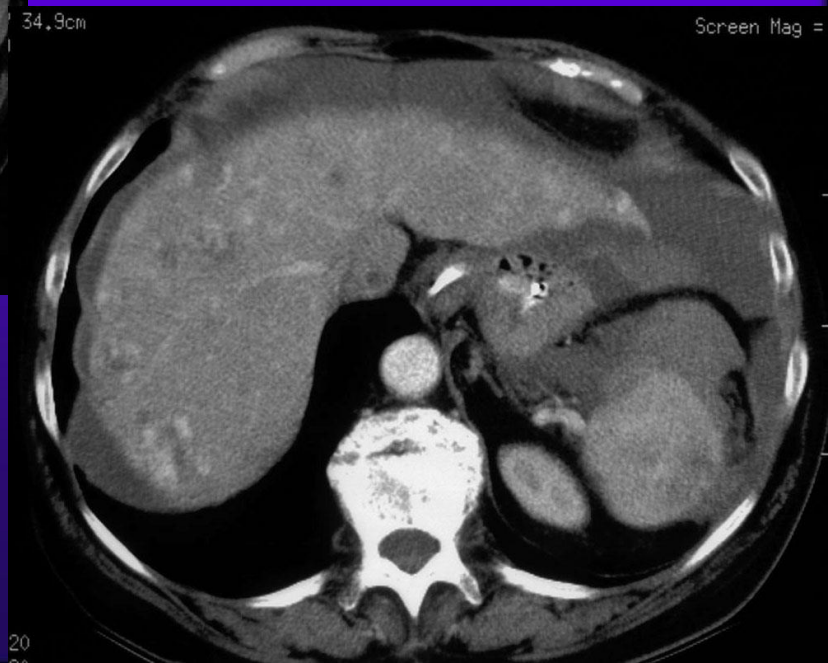


Hemorrhagic Tumors

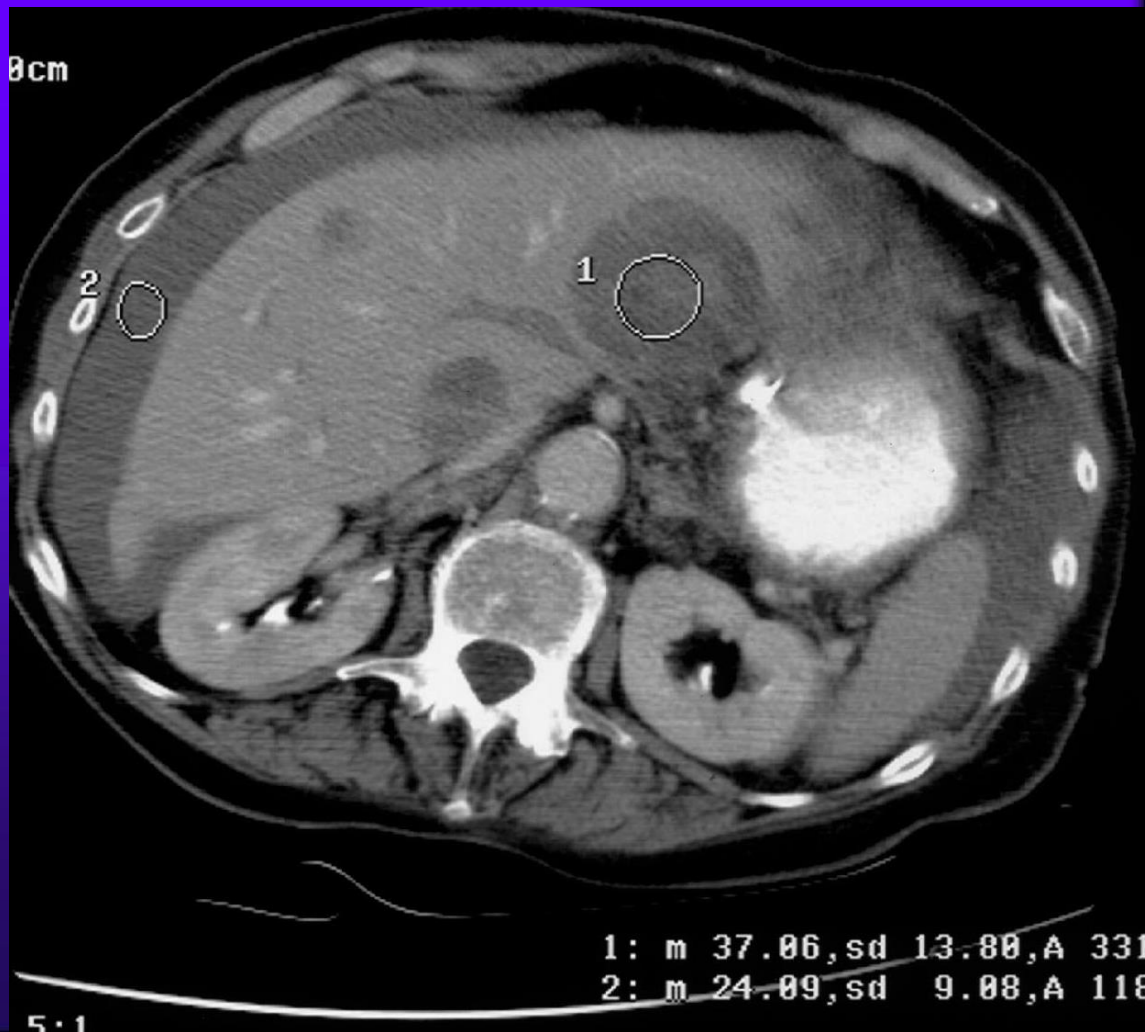
- Also hemorrhagic liver metastases – hypervascular tumors (melanoma, angiosarcoma) – but also colon & lung cancer hepatic metastases
- Rapid diagnosis is essential – mortality from ruptured HCC is as high as 85% - despite intervention, remains as high as 65%; only 20% survival at 4 months after surgery
- Reports of longer survival in more recent series
- Hepatic arterial embolization is an appropriate alternative to surgery (Hsieh JS et al. AJR 1987)
- Manage hemorrhagic non-HCC hepatic tumoral foci similarly, although adenomas are typically resected

68-year-old man with hepatic and splenic angiosarcoma

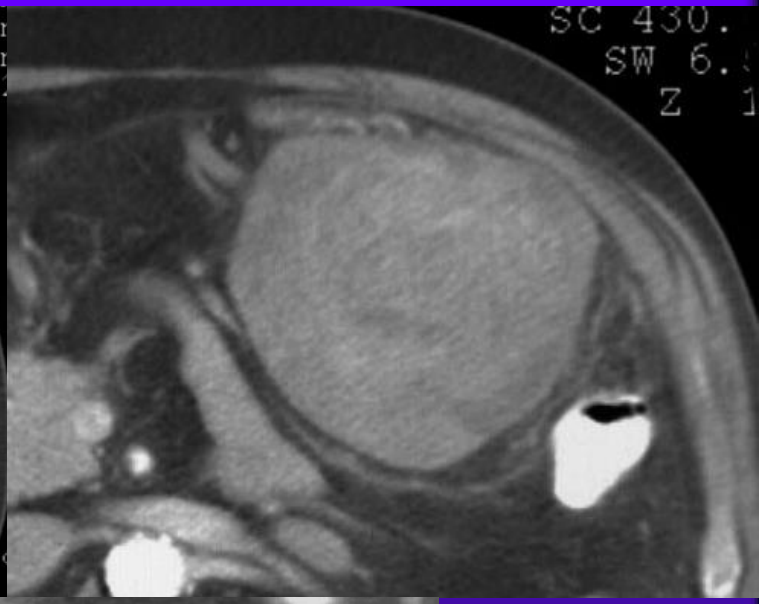


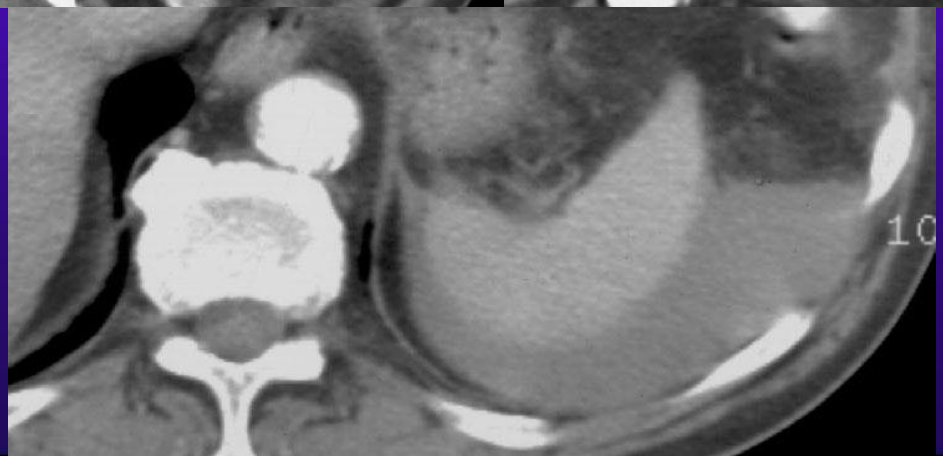


72-year-old male smoker with severe abdominal pain – hemoperitoneum secondary to lung cancer metastases to liver



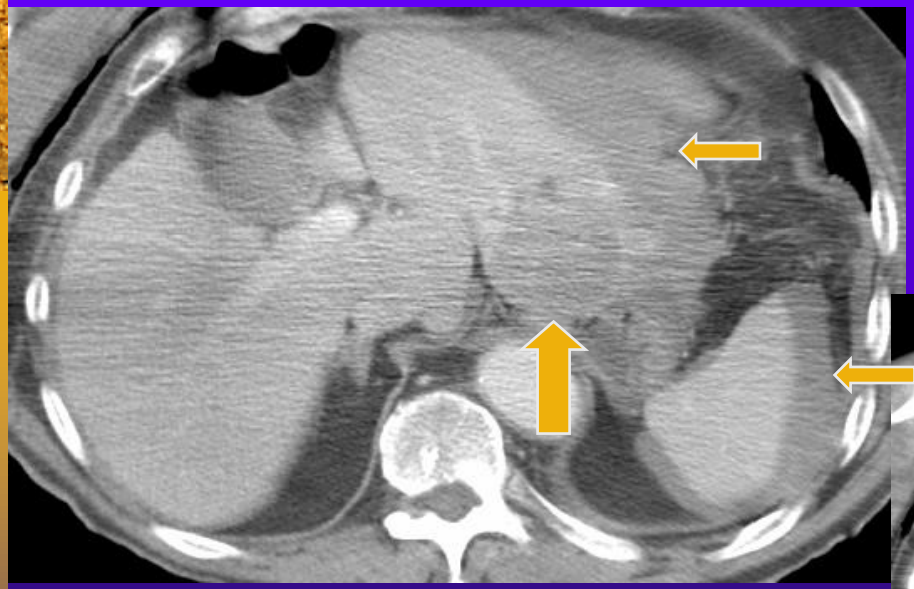
69-year-old man with acute left abdominal pain – hemoperitoneum secondary to GIST

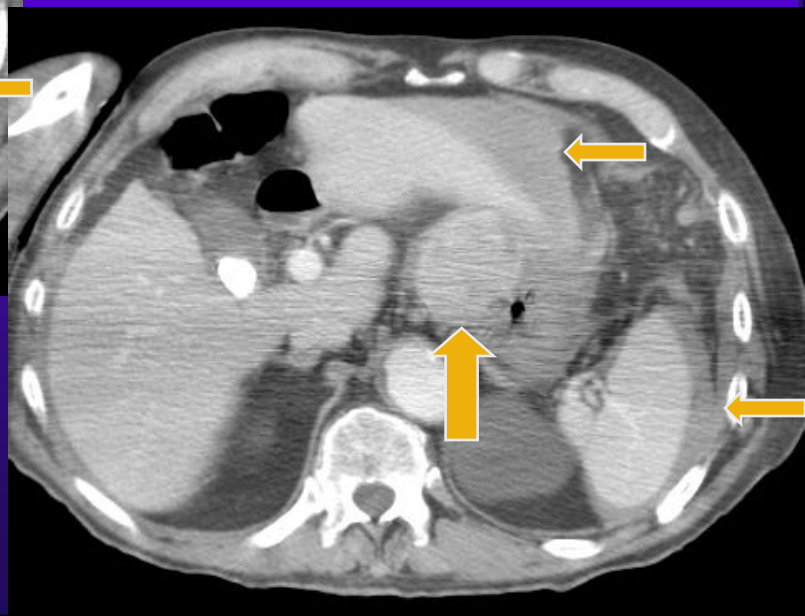




80-year-old man with acute onset severe abdominal pain

- GIST vs. exophytic HCC vs. metastasis (h.o. bladder CA); hemoperitoneum; AFP was 30,000+





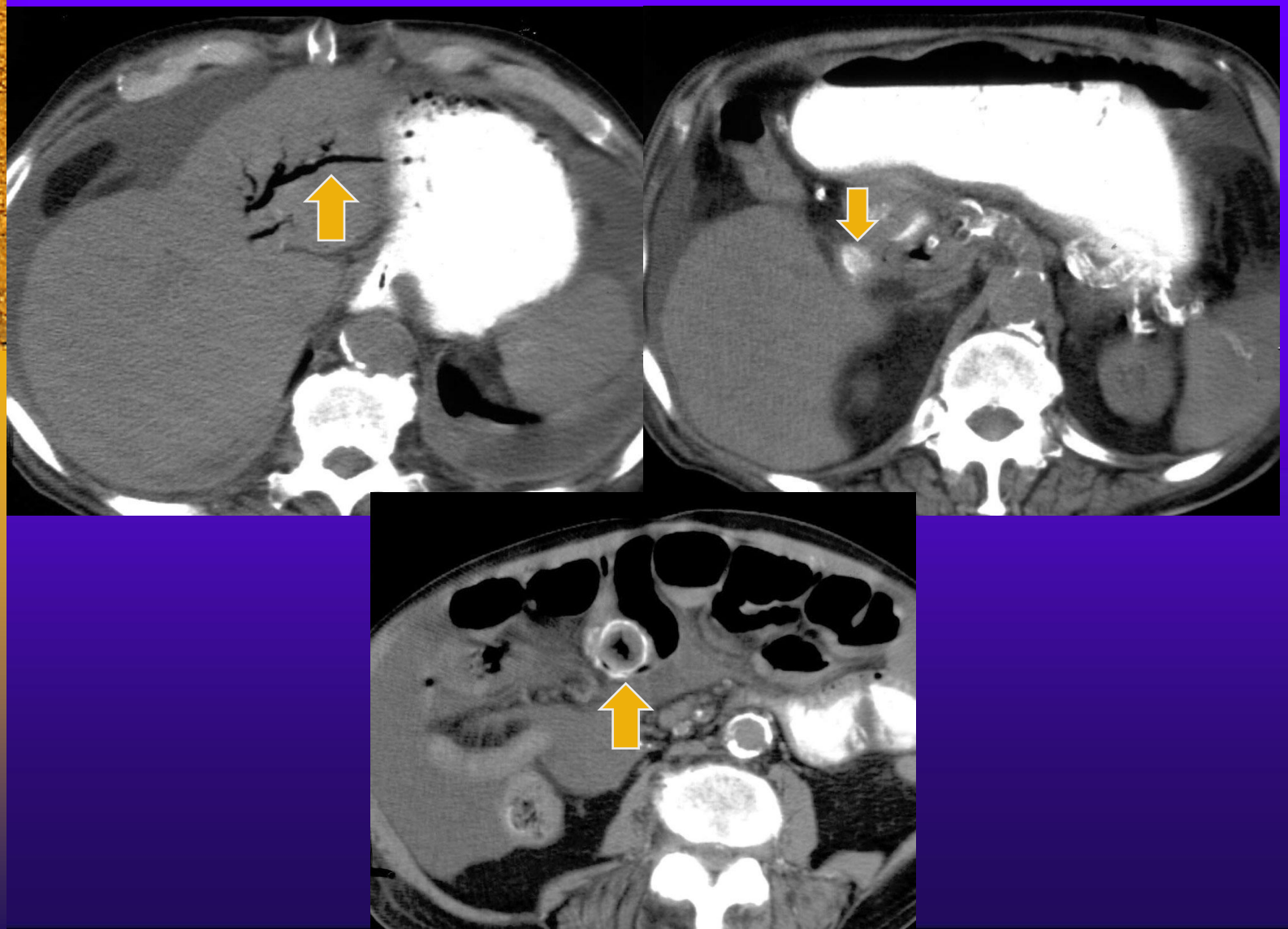
Gallstone Ileus

- Gallstone ileus is NOT an adynamic ileus
- Bowel obstruction secondary to a gallstone which has eroded into the GI tract; usually a result of chronic cholecystitis
- Gallstone usually erodes into duodenum, but obstruction occurs at site of narrowing, especially the ileocecal valve; less likely at the duodenal-jejunal junction, sigmoid colon, or at a pathologic site of stricture (e.g. in t.i. in 17 patients, & jejunum in 5 patients (Ayantunde AA et al. World J Surg 2007))
- Rarely – obstruction at stomach/proximal duodenum (Bouveret's syndrome (Pickhardt PJ et al. AJR 2003; Singh AK et al. AJR 2003; Gan S et al. AJR 2008))

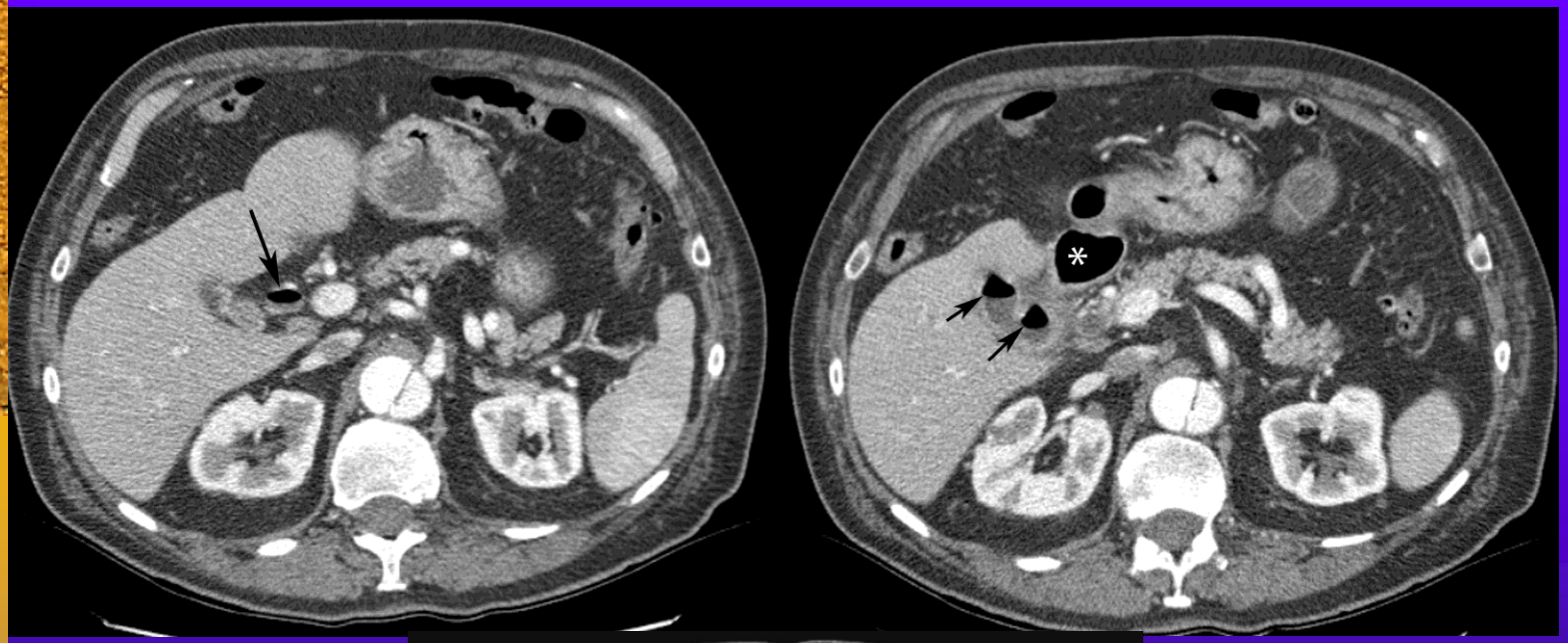
Gallstone Ileus

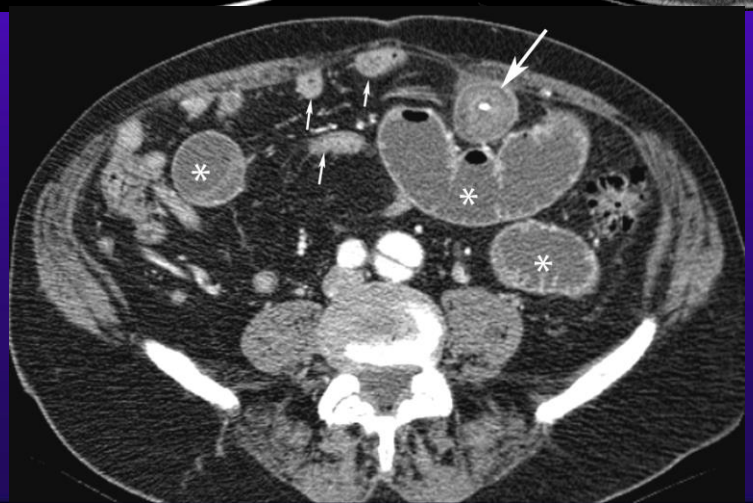
- Difficult to diagnose clinically; most patients present with pain & vomiting (Ayantunde AA et al. World J Surg 2007)
- CT findings are usually characteristic: the equivalent of Rigler's triad (Swift S et al. Clin Radiol 1998; Loren I et al. JCAT 1994):
- - bowel obstruction
- - pneumobilia (in gallbladder/bile ducts)
- - radiopaque calculus at transition zone
- - the triad is not present in all patients – pneumobilia is variable, & the gallstone may be difficult to see if not calcified, so the radiologist needs to be aware of these potential pitfalls (Reimann AJ et al. JCAT 2004)

79-year-old man with abdominal pain

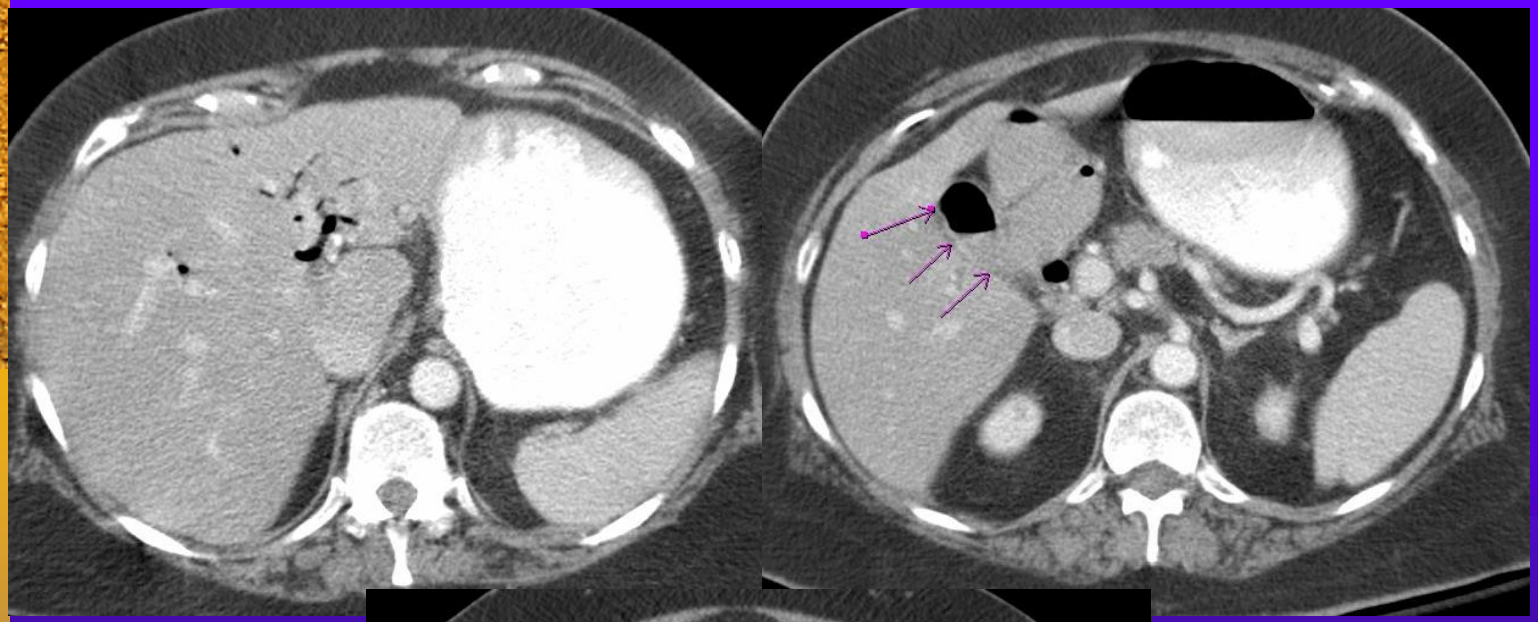


61-y.o. man, known type B aortic dissection, with acute abdominal pain

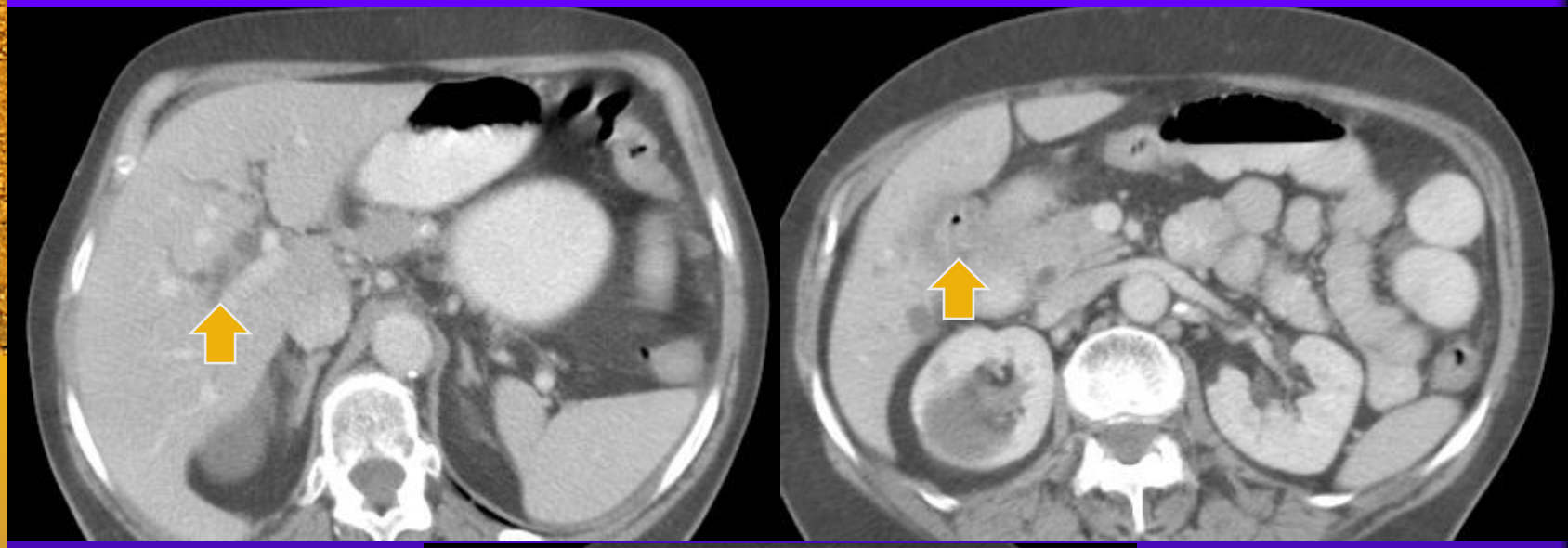


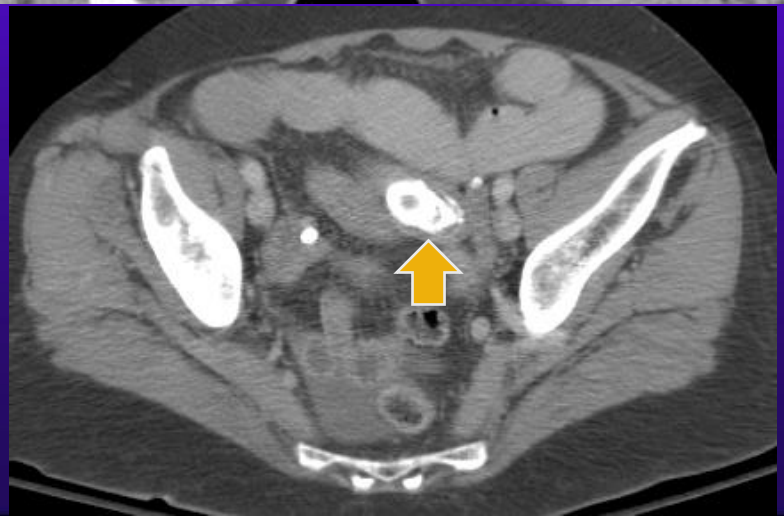


63-y.o. woman, abdominal pain & vomiting



76-y.o. woman, n/v and abdominal pain



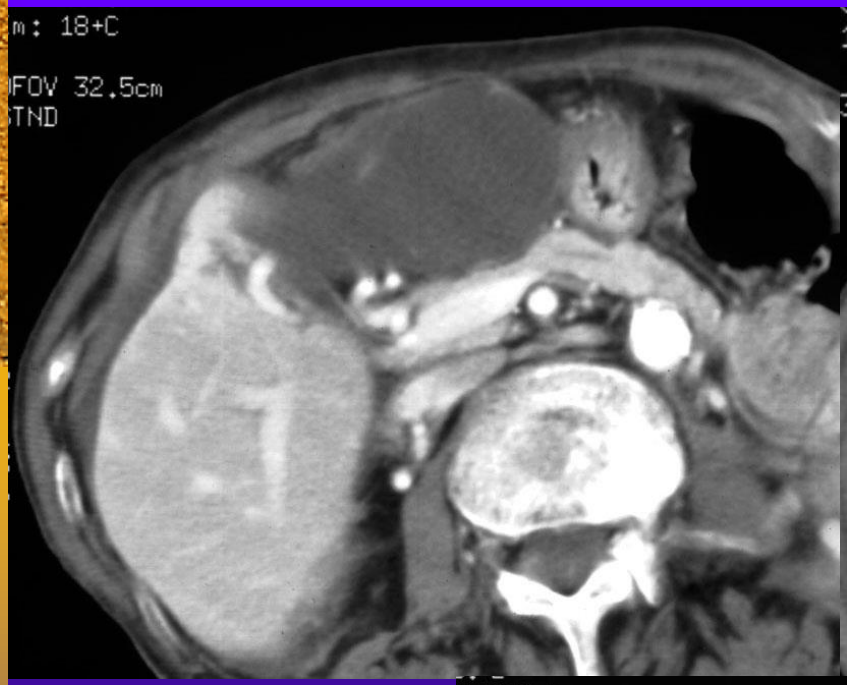


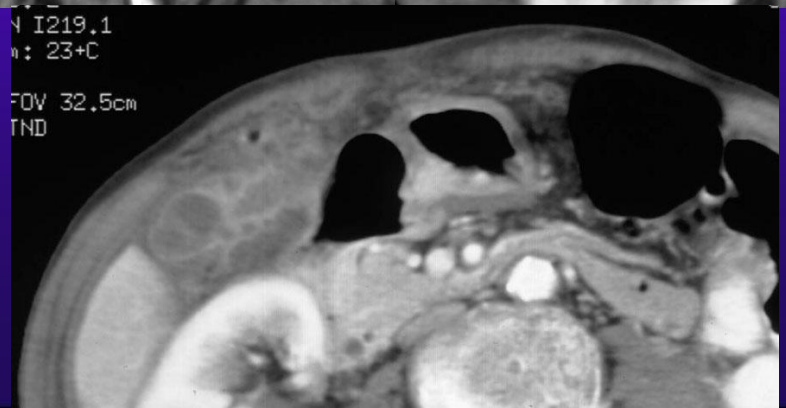
Gallstone Ileus

- 27 patients, retrospective comparison of CT & x-rays (Lassandro F et al. Eur J Radiol 2004): pneumobilia in 89% & ectopic stone in 82% on CT; Rigler's triad found in 78% on CT c/w only 15% on radiographs
- Similar findings in 23 patients: 89% ectopic calculi visible on CT c/w 50% on radiographs (Liang X et al. Eur J Radiol 2015)
- Calculus size variable, but usually > 2.5 cm; watch for > 1 endoluminal calculus on CT, to avoid repeat episodes – in 5/40 cases (Lassandro F et al. AJR 2005)
- Morbidity/mortality may be substantial, especially in elderly patients; treatment is surgery, with specific management individualized

Tenth diagnosis – unknown case

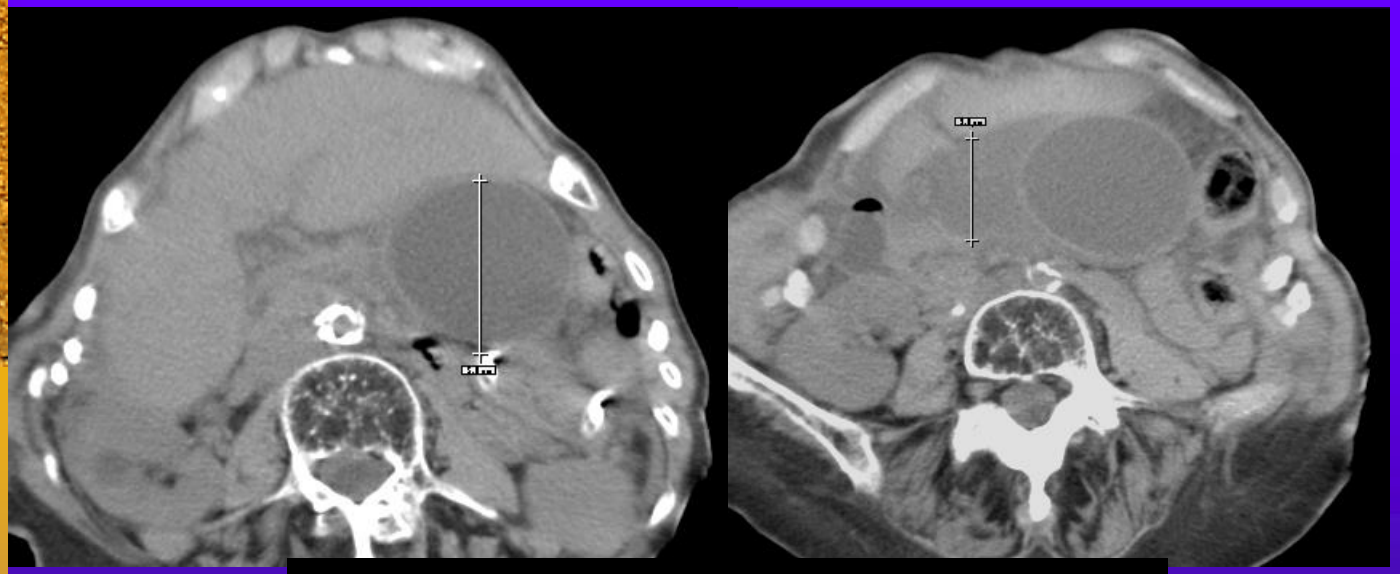
- 85-year-old man with abdominal pain

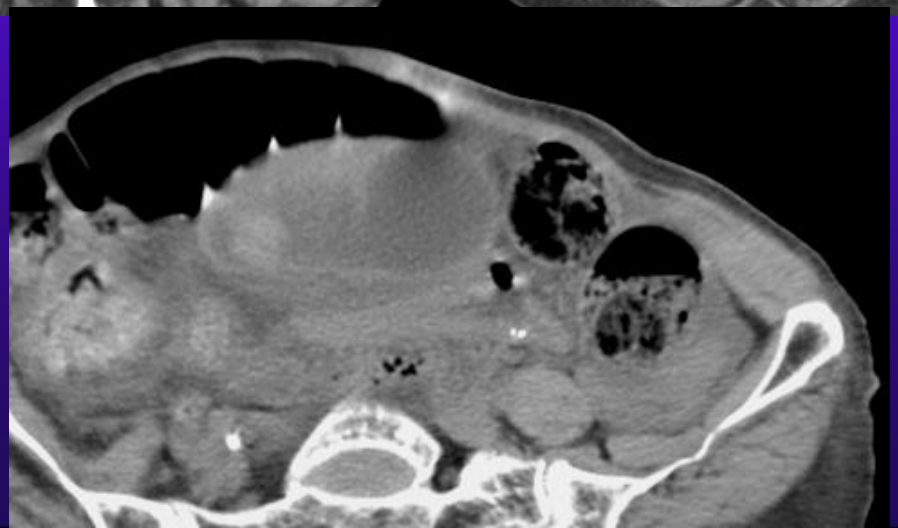




Companion Case

- 86-y.o. woman with nausea, vomiting, and abdominal pain





Gallbladder Torsion/Volvulus

- Rare, usually not diagnosed preoperatively
- Long mesentery predisposes – along with GB without mesenteric attachments and large gallstones that may cause mesenteric elongation
- May be incomplete (<180 degrees) or complete
- First reported in 1898 by Wendel – the “floating gallbladder”
- Kyphosis, atherosclerosis, and vigorous GB peristalsis also implicated
- 3:1 female to male, usually elderly patients

Gallbladder Torsion/Volvulus

- Clinical/radiology similar to acute cholecystitis – fever, RUQ pain, etc.
- One review of 400 cases – only 4 diagnosed preoperatively; gangrene in ½ (Hinoshota E et al. Hepatogastroenterol 1999)
- Most suggestive imaging finding – unusual position of GB, especially horizontal lie (Quinn SF et al. AJR 1987); also location of cystic duct to right of GB, conical structure at GB neck (Aibe H et al. Abdom Imaging 2002)
- Treatment is surgery

Conclusion

- A spectrum of uncommon/unusual GI causes of the acute abdomen may be diagnosed prospectively on CT.
- Ten representative diagnoses were covered in this presentation.
- Radiologists and clinicians need to be aware of these disorders even when uncommonly encountered, with the widespread use of CT to image patients in the emergency setting.
- Further reading: Katz DS, Yam B, Hines JJ, Mazzie JP, Lane MJ, Abbas MA. Uncommon and unusual gastrointestinal causes of the acute abdomen: CT diagnosis. Semin US CT MRI 2008.